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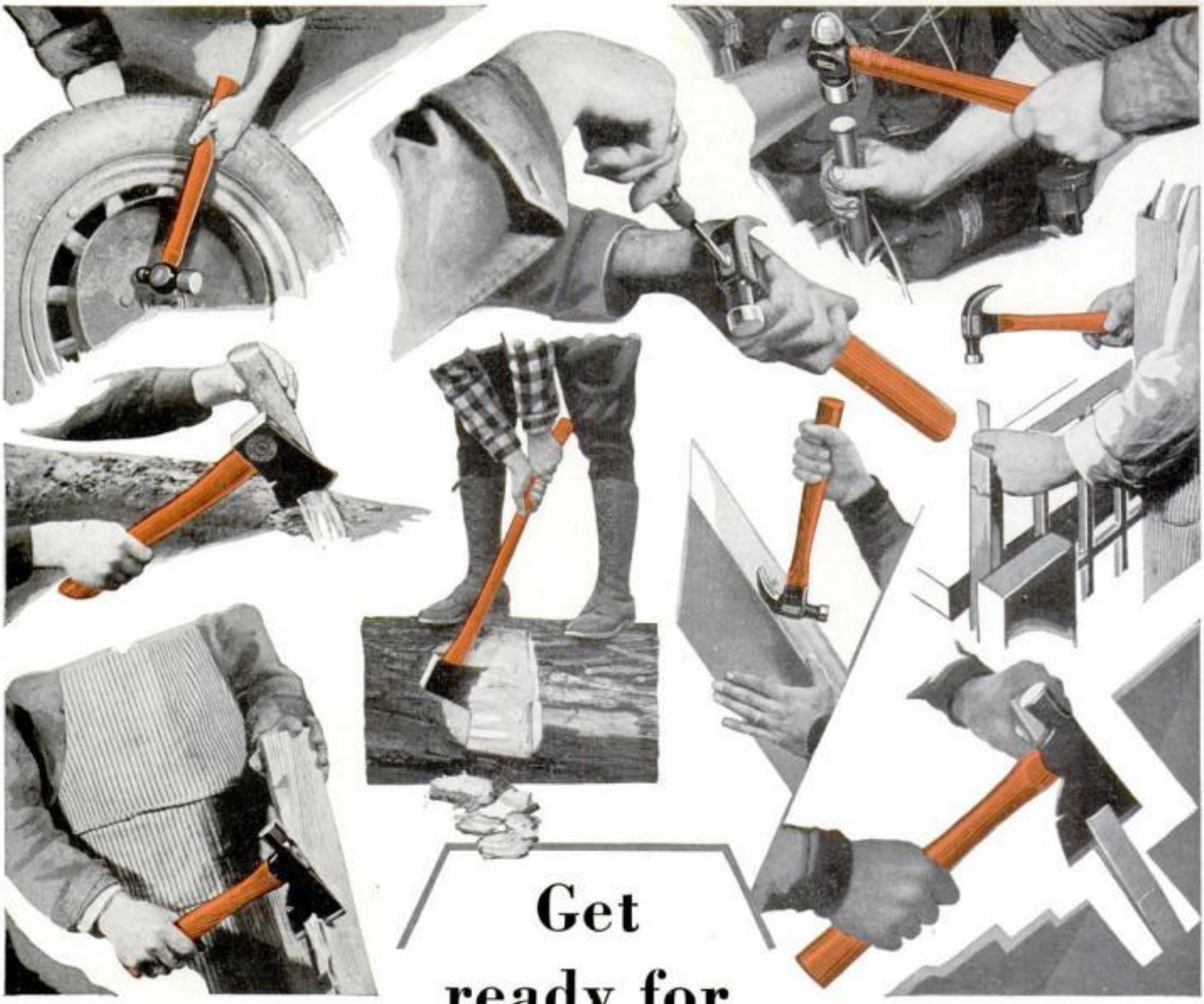

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March, 1931, Vol. 118, No. 3. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Nine months' subscription, $2. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. A. L. Cole, President and Treasurer; R. C. Wilson, Vice-President; John Nichols, Vice-President; F. W. Briggs, Secretary.

Popular Science Monthly for March, 1931

HEALTH AND HYGIENE

LABORATORY DISCOVERIES

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How to Buy a Home That Fits Your Pocket

By LEON MEADOW, *Financial Editor*

HENRY CRANE looked at his watch and yawned. "Don't you think we'd better call it an evening, Elizabeth? I can't remember the last time we talked, planned and argued so long about any one thing in our whole lives."

His wife smiled. "It's not every day," she replied, "that we decide to own our own home."

"Of course—but the deeper we go into this thing, the more planning we do, the more puzzled I get about this business of owning a home. The size and style of the house, the cost of upkeep, the amount we can afford to spend—all these questions are mysteries to me. That's why I think we can drop the discussion now, until I go over it all with someone who knows."

Her eyes sparkled with happiness. "Well, don't let it drop now, Henry. Be sure to talk it over with someone who does know, and then let's discuss it together again."

"Let me see . . . there's a chap downtown, Gordon's his name. That's it— Don Gordon. I've met him a few times. He's an architect who specializes in building small homes. Now that I think of it, Sid Nicholson once told me that Gordon planned his home for him and showed Sid how to finance it properly. If I remember correctly, this fellow Gordon has a reputation for that sort of thing. I'm going to drop in and see him tomorrow. I certainly ought to be able to learn something from him about home buying and building."

"I hope so," Elizabeth replied.

Henry was right. After spending an hour in Don Gordon's office he was beginning to understand how people went about buying a house. Like himself, most of them had a vague idea of what kind of house they wanted, and that they could pay toward it as much as they were now paying for rent—but that they knew very little about getting an absolutely satisfactory home. One that would not absorb too much of their income and yet, not be below their normal standard of living.

"We've found," said Gordon, "that, if a family devotes one sixth of its income to rent, it should be able to put one fourth of it toward buying and maintaining a home. This amount, when used for the latter purpose, will actually include both rent and savings. Why? Because we assume that on your first mortgage you will pay interest charges, the same as you now pay rent. Also, you will pay amortization charges each year—that is, a fixed payment that constantly reduces the principal of the mortgage. Every payment of this type is really a savings deposit—as, after a number of years, you will have reduced the principal debt entirely—and will own your home free and clear.

"Total annual payments on a house may require anywhere from 1/8th to 1/3rd of your income, depending of course upon your particular circumstances."

"Yes," put in Henry, feeling a bit overwhelmed by all these facts and conditions. "I think I follow you so far. But what bothers me is how I decide how much I can afford to pay for my house and lot. Isn't that the logical base upon which all these other factors rest?"

"We're coming to that, Henry. But first there are other things to consider. For instance, there's the matter of cash. Regardless of how much your house costs and how much your income is, you have to be prepared to put up at least 20% of the total value of your house and lot in cash. No reliable bank or loan association is going to lend you more than 80%."

"That's true," admitted Henry. "I hadn't thought of that. But I'm fixed up pretty well as far as cash goes."

"Of course it's true," continued Gordon, "and you'll have to consider something else, too. The exact amount to be spent on your home can best be determined only by careful checking over the family's income, needs, and expenses. That means practical budgets covering all the varying and fixed items that come under those heads. But consider all that settled, for the time being. Now tell me, what's your income?"

"About $5,000 a year. Why do you ask?"

"Just to get back to your own question of how much you can afford to spend on your house and lot. $10,000 is top for you."

"How do you figure it?" interrupted Henry.

"It's not my estimate, Crane. Government research on home economics and financing, the long experience of building and loan associations—all have arrived at it. Under ordinary circumstances a family can afford to live in a house whose value, together with the lot, is twice as much as that family's income. That means you would have to put up at least $2,000 in cash to buy the property and build a house worth $10,000."

"And," Henry interrupted again, "if I can put up $4,000—would that help?"

"Yes, considerably. The mortgage loan will be much easier to obtain and the burden of financing the whole thing will be much lighter for you." Gordon rose and after a few minutes at a filing cabinet across the room, he came back with a chart in his hand. "Here's a very interesting table on this subject," he said, sitting down and placing the sheet on his desk.

"This," said Gordon, "is part of a table which appeared in a bulletin published by the U. S. Dep't of Commerce. Perhaps a bit of explanation will give you the meaning of it more quickly."

"Fair enough," replied Henry, lighting a cigarette. "Let's have it all."

(Continued on page 6)

How to Buy a Home That Fits Your Pocket

(Continued from page 4)

Table Showing Income, Value of Home, and Typical Annual Expenses for House and Lot

1. Value of house and lot	$7,000	$8,000	$9,000	$10,000
2. Annual Income	2,800 to 4,200	3,200 to 4,800	3,600 to 5,400	4,000 to 6,000
3. 1st cash payment, 40% of value	2,800	3,200	3,600	4,000
4. Amount of loan	4,200	4,800	5,400	6,000
5. Int. & amortization (12% of loan)	504	576	648	720
6. Estimated taxes, insur. and upkeep	280	320	360	400
7. Tot. Annual Exp.	784	896	1,008	1,120
8. Savings inc. in above total, (1st year)	252	288	324	360
9. Savings comparable with rent (1st year)	532	608	684	760

"Item 1," began his friend, "is the value of your house and lot. At the top of the last column on the right is the figure, $10,000—the sum we've decided you can afford to spend. This is dependent on Item 2, your annual income and, as you can see, directly beneath the $10,000 are the figures $4,000 to $6,000. Notice this, Henry: the figures for the various income groups overlap each other all along the row. This was done because no two families with the same income ever spend the same amount for their homes. Size of family, preference of location and other varying conditions are the principal causes for this difference. But look how this table justifies my previous statement about the house and lot being valued at twice as much as the annual income. The average income between $4,000 and $6,000 is obviously $5,000—and the house and lot in this case are valued at $10,000. So that's that."

"Right you are, Don. A great light is dawning."

"Then you better go cautiously. More often than not people are blinded by these so called "great lights" and lose sight of everything else. Item 3 is self explanatory. Your first cash payment is 40% of the total value—or $4,000. Item 4 is also obvious; the balance, or amount to be borrowed, is $6,000.

"That brings us to Item 5—interest and amortization on the loan. Apparently these figures were taken from the conditions laid down by building and loan associations. 6% goes to interest and 6% to reduction of the principal. Incidentally, if these figures are extended I think the loan can be paid off entirely in less than 12 years."

"One minute Don, that doesn't sound right to me. Your annual payment for Item 5 is $720. Half of that, or $360, goes to reduction of the mortgage. Then, in twelve years about $4,000 will have been paid off. So how do you figure that the whole loan will be cleared?"

"I was coming to that. Most building and loan associations arrange the loan so that you only pay interest on the *net principal*. In other words, after the first payment of $720—the $6,000 has been reduced by $360 to $5,640. Next year you still pay a total of 12% on the $6,000, but out of that $720 is taken interest on only $5,640 and the rest is applied to reducing the loan. So that, every year, as your principal decreases, your interest charges also diminish and a larger balance of the $720 goes to amortizing the principal. In about 139 months, I believe, the whole debt has been cleared.

"Now, here's Item 6—estimated taxes, insurance and upkeep. Well, local tax rates usually run from 1½ to 2½% of the market value of your property—insurance to about ½ of 1% of the value of house alone—and upkeep is generally estimated at 1% of the value of the house. Of course, all these percentages may vary but, ordinarily, they're fairly representative of the average for these expenses. In fact, $400 for this item is well above the average figure, so that you need not be afraid of underestimation. Item 7 is just the addition of Items 5 and 6, *not including* such extra expenses as water, fuel, light, phone, special assessments, etc. The majority of people when paying for a home spend between 18 and 35% of their incomes for Item 7, plus these additional expenses, according to Department of Commerce figures. In your case, the $1,120 for this item is about 20% of your income—so that there is still plenty of lee-way.

"That brings us to Item 8—the savings included in the total for Item 7, for the first year. You remember I said that half of that $720 went to reduction of the loan and that it could be considered as savings. This accounts for the figure of $360 under item 7.

"Now for Item 9. The $760 in this column is the difference between Items 7 and 8—or the difference between the total expenses for the house the first year, and the amount of savings represented by the reduction of the mortgage loan that same year. The balance is comparable with rent expenses. But as you know, rent expenses are fixed charges; whereas Item 9 will grow smaller each year.

"It is rather complicated," Don continued. "You see, Item 8, your savings, or the reduction of the loan, grow bigger each year, as I already explained. Naturally, the larger this gets, the less there will be left when subtracted from the total annual expenses in Item 7. In other words, if Item 8 should be $400 next year—and you subtract this from the $1,120 in Item 7—there would only be $720. So it all comes down to this: now Item 9, the net annual expenses for the house is about as much as your present apartment rent. Each year following it will be even less. After 12 years, when the mortgage is paid off, there will be left only the expenses of taxes, insurance and upkeep—$400 according to Item 6. This is less than half your present rental expenses.

"Now do you know more than you first did?"

"No question about that, Don. You've certainly been a great help. One thing more, the property—how much of the $10,000 goes to that item?"

"That's not hard," Gordon replied. "Where no improvements have been made in the locality, you should spend from 5 to 18% of the total for your lot. Where they have been made, then 20% or $2,000 is fair. Never more than 25%, at any rate. Before you buy anything or make any agreements, have the lot appraised by a disinterested and expert third party. Now, when you apply to your bank or loan association, under ordinary conditions they should be willing to lend you up to 80% of the total value of house and lot. If, as in your case, you apply for a loan of 60%—with the intention of building on the property—and it is refused, then watch your step. It generally means that the price of the property is too high. Things like this prove the wisdom of checking up first and buying later. Will you excuse me now, Henry? I must run along and keep an appointment uptown."

"Of course, Don,—I've kept you long enough as it is. If you're as good an architect as you are a home financing adviser, I know who's going to design my house for me."

Gordon laughed. "And if your home is designed as well as it can be financed, your architect, no matter who he is, will have done a good job."

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

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The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

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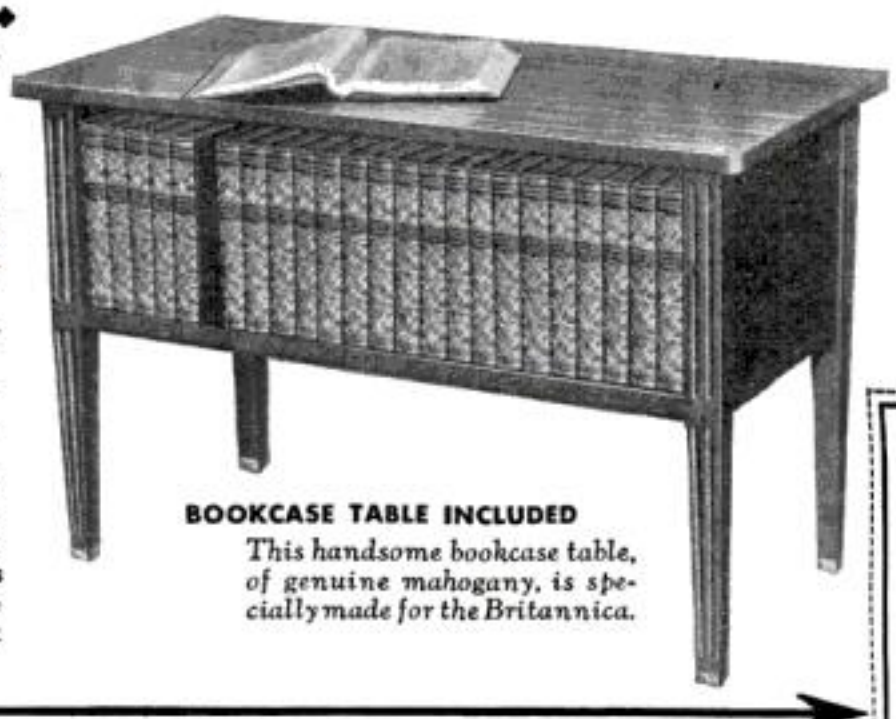

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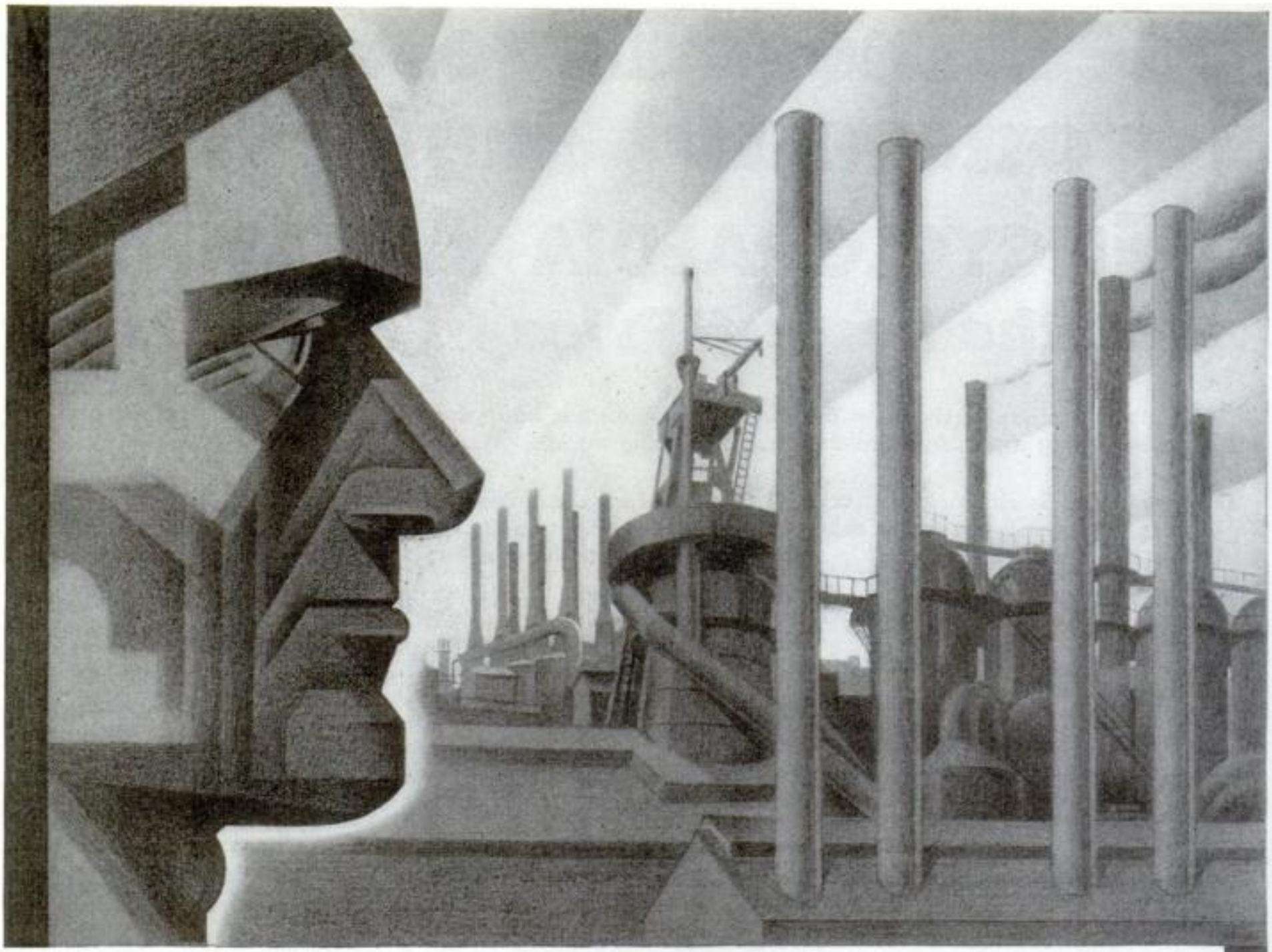

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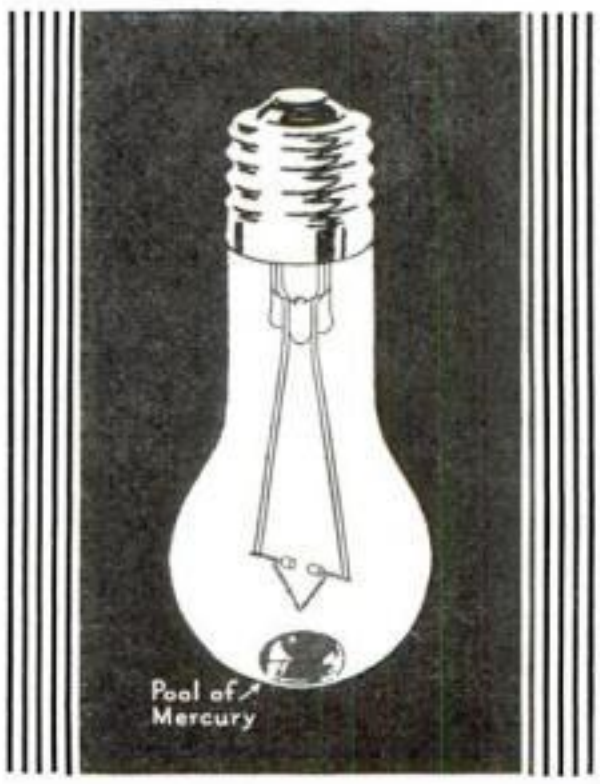
For countless centuries these people turned gratefully to the sun, worshiping its benevolence. Belief in the goodness of sunshine is something that is born in every one of us, a heritage from those far off days when the cave man selected his residence to face the sun and the Romans built lavish solariums better to enjoy the health-giving energy of sunlight.

Unfortunately for most of us, as physicians and scientists realize, the sunshine that our forefathers knew, a kindly beneficent season out in the open under a cloudless sky, free from smoke and dust and dirt, is gone. Economic necessity has made of us a nation of sun dodgers, hiding away in closely packed buildings in the daytime, working and playing behind glass that screens out the ultra-violet rays of sunshine just as surely as the window shades screen out the visible rays of the sun's light. We bundle up our bodies. We ride in subways and street cars and automobiles, almost totally cut off from the sunshine which our forefathers enjoyed as a matter of course. Even when we get out-of-doors in our cities, smoke and dirt cloud the air and rob the sunshine of more than three-quarters of its active health-giving rays. And then winter comes; and the sunlight loses most of its health value. Lucky, indeed, it is for us that we know more about the sun than the Romans did—than even



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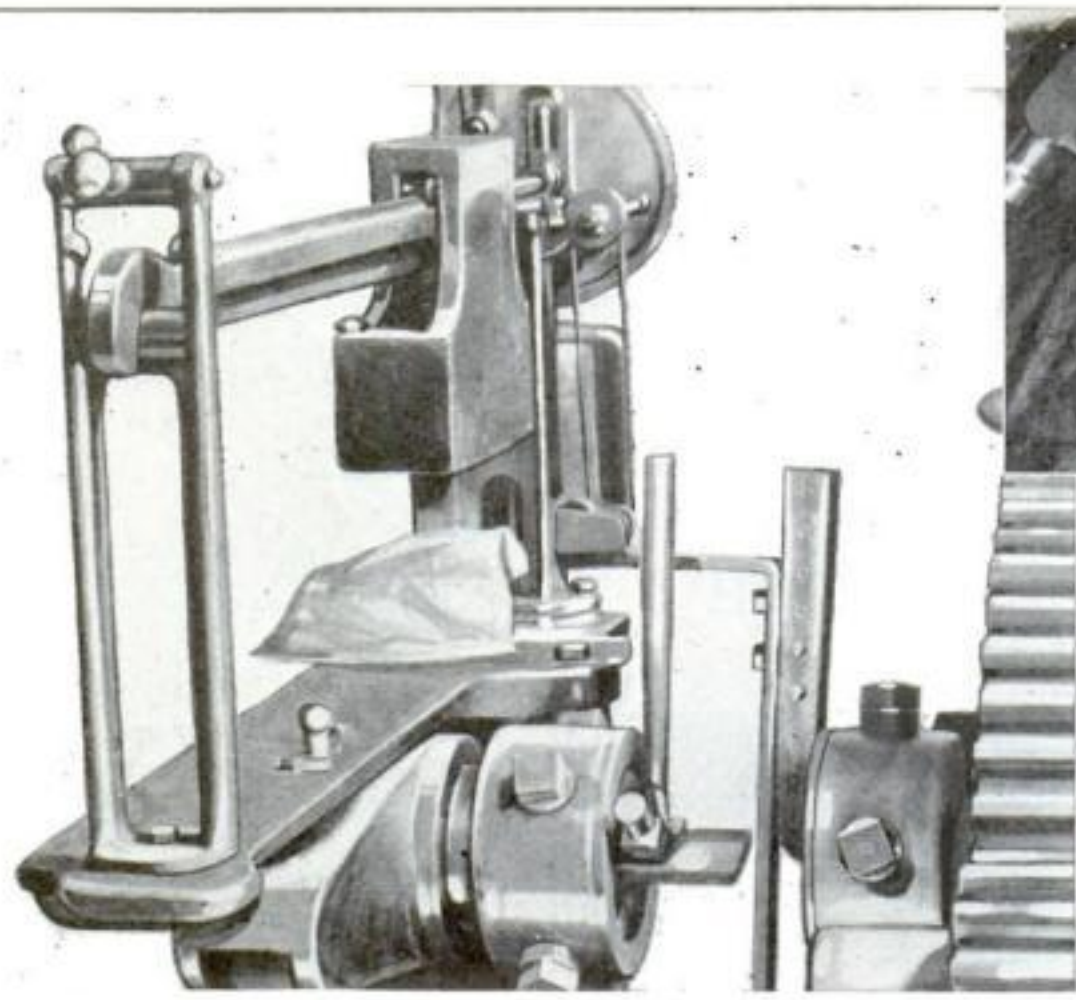
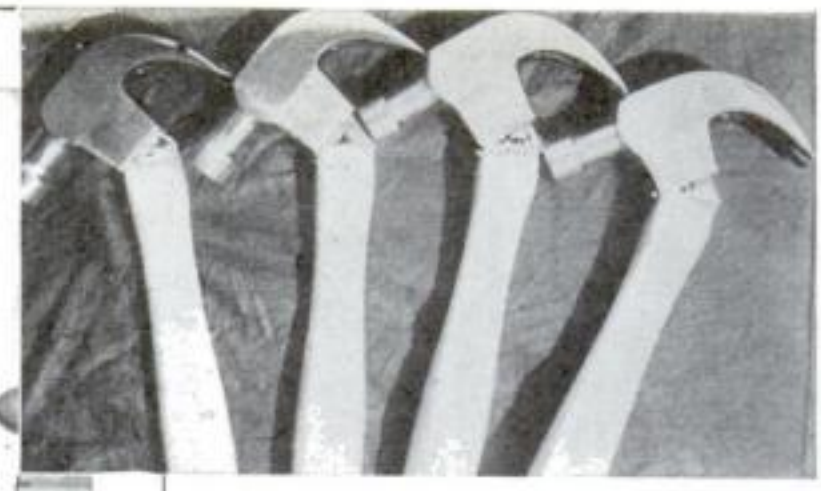


This torsion machine is used in testing the strength of claws and strength of handles of hammers. Loads up to 3,000 inch-pounds may be applied.



Here are four specimens that have undergone test in the machine illustrated at the left.

You Should Choose Hammer Carefully

By COLLINS P. BLISS

Dean, College of Engineering, N. Y. University; Director, Popular Science Institute

IT LOOKS as though one hammer ought to be pretty much like another but, as a matter of fact, there is actually room for much difference, though this difference is not readily apparent to the average buyer.

The variation in hammer quality lies not only in the hammer head but in the handle itself and in how it is attached to the head. The best made handle may be worthless when wrongly inserted and this is a shortcoming that Popular Science Institute has found in many hammers that it has tested.

In the first place, the hole in the head must taper both ways from the midpoint and have the greatest taper on the head end of the opening. There must be a shoulder on the handle, so when the handle is tapped at the end, the head will come down firmly on the shoulder and not split slivers off the handle. It is better to have considerable play in the hole of the hammer head and use wedges to spread the wood rather than have too narrow and straight a hole, which tends to let the head work down on the handle. The face of the hammer head should be hard at the center and softer at the edges; if not, chipping of the edges results.

Besides proper insertion of the handle, the following points are important in determining the merit of a hammer:

1. The strength of the claws for nail pulling.
2. The strength of the handle.
3. The hardness of the hammer head.

When a hammer is being tested by Popular Science Institute to determine the strength of jaws for nail pulling, the method used is to place a steel plate about one half inch thick and four inches wide in the chuck of a torsion machine. Holes then are drilled in this plate for various sized nails, and nails exactly fitting each hole are forced through, leaving enough for the claw of the hammer to grip the head of the nail.

THE shank of the nail is turned flat against the underside of the plate and a steel clamp holds it against the plate. The twisting head of the testing machine then revolves and the lever extension puts a gradually increasing load on the handle, bending it as shown in the photograph at the top of the page. If it is a good hammer, it will pull out the nails or strip the head before the claws give way.

The next test is to establish the strength of the wood used in the handle, and to do this a steel bolt is substituted for the nail, with a nut holding it so the hammer cannot pull it out without stripping either the threads or the head. The testing machine is then set in motion and pressure is applied until the handle breaks. A dial records the inch-pounds of pressure. To be approved by Popular Science Institute a hammer handle has to withstand a minimum pressure greater than can be exerted by a man.

In the illustration will be seen four specimens of a particular make of hammer after they had gone through this handle test. These hammers stood 1,725, 1,850, 2,325 and 1,975 inch-pounds, respectively, before they ultimately gave way.

The face and wedge test to which hammers are subjected consists of 10,000 blows in a striking machine. The purpose of this test is to see if the face is affected (whether the steel is too soft or too hard) and also to determine whether the head is properly wedged.

To test the hardness of the various parts of the hammer head, two machines are used. One is a scleroscope, in which a hardened plunger strikes the part to be tested. The plunger rebound is measured and by an engineering formula shows the hardness of the steel used. Another test to determine the hardness of a hammer head is made with the Brinell testing machine. In this test a hardened steel ball is forced into the metal. The circumference of the tiny hole made by the hardened steel ball is then measured and again an engineering formula is used to determine the precise hardness of the steel.

CONSIDERING how alike hammers are in appearance, it is surprising how their reactions differ under these tests. They explain what many buyers find hard to understand; that is, why one hammer will cost $1.50 and another but fifty cents when one looks only slightly better. The dollar's difference usually lies in the fact that the $1.50 hammer will stand up under hardest usage by a carpenter for a lifetime while the cheaper hammer is likely to break under the first hard blow.

WHEN —

When did Man come to walk upright?
When was the eagle a reptile?
When does an oyster change its sex?

WHY —

Why can a lobster grow new limbs, while we cannot?
Why does fear give us "goose-flesh?"

HOW —

How may the mysterious "X body" determine a baby's sex before birth?
How can a moth locate his mate a mile away?

WHERE —

Where is the "private secretary" of the brain?
Where does the female skeleton threaten to stop all further human evolution?

Can we control the Sex of our babies?

WHAT *would* not kings have given for the secret? What heartaches it would have spared their queens — perpetual victims of the demand for "An heir to the throne!"

The entire course of history has often been changed — because Nature withheld the secret of controlling or determining in advance the sex of a baby!

Today Science is discovering laws that may decide (while the human cell is still a pinhead in size) whether it is to produce a boy or a girl. How this power is at last yielding some of its secrets to the probing searchlight of modern science has just been told by H. G. Wells, in his new companion-work to the "Outline of History" — THE SCIENCE OF LIFE!

At Last — The Story of All Things Living

After publication of *"The Outline"* Mr. Wells began exhaustive research for this new companion-work. In the tremendous 5-year task of writing it he had the collaboration of the distinguished scientist, Julian Huxley, and his own son, the physiologist, G. P. Wells.

At last it has been completed! What Wells did for the story of *Man* in "The Outline of History" he now does for the story of *Life* itself in "The Science of Life"!

Wells' "Outline" reviewed *human history* as one continuous march of human *events*. Wells' new *"Science of Life"* widens the focus and reviews the continuous development of *life itself* — tracing its myriad forms and mysterious phenomena, the fierce age-old struggle for survival, the sources of the equipment which is inherited or acquired for existence — and how, out of this, emerges the dominant species, Man, with the marks of his own origin still upon and within him!

In Four Epoch-Making Volumes

Over Wells' pages stalk forty-ton monsters. Dodging beneath them run tiny creatures destined to outlive these freak monsters and become ancestors of nearly all modern animals, including man himself.

In a still more ancient scene you see — as only Wells can *make* you see — a little worm-like thing trying, century after century, to make his way up a river, until he finally invents something enabling him to succeed!

Still further back, in the dimmest mist of time, you see a world devoid of any life except tiny drops of jelly with hairlike stems.

First Edition Now Being Released

Here, in unforgettable chapters, are riddles of life that have puzzled *most* people — answered in a way *all* people will enjoy and understand.

Some of Science's amazing findings may startle you — upset long-cherished ideas. But you will be enlightened and stimulated. You will learn, as only Wells can tell you, what is known about Nature's ceaseless experiments with life in all its forms through the ages.

You Have "Gyroscopes" in Your Ears!

Just as the "gyroscope top" balances itself on a string, so a leveling device in each ear enables your whole body keep its balance. Without this "Stabilizer" man could not walk, run, drive a car or airplane.

A Bird Who "Sets a Stage" for His Own Wedding

When the Bower bird wishes to win his lady, he builds a theatre — decorates it with bright berries, flowers, and gay feathers — then struts and dances until she is enthralled by his charms.

We All Have Fishes' Gills and Monkeys' Tails!

Parts no longer used shrink and are covered up. The crosses on the human figure above show a few of the 180 places where science has found "vestiges" of formerly important organs.

This Frog Had No Father!

Can Nature learn to produce life without the help of the male? This frog was developed by an apparently "magic" process involving the piercing of an unfertilized egg.

The First "Stomach" on Earth

This speck of living jelly eats microscopic plants. It flows around them, drawing them into its body.

"Look Out! I'm an Alligator!" Says This Harmless Insect

The South American lantern-fly "bluffs" birds who might want it for dinner. . . The front of its head is a sham, moulded and colored to imitate a small alligator's!

Is King Alphonso's Chin 500 Years Old?

The prominent lip and jaw has recurred in his family since 15th Century. Persistence of family likenesses is due to dominance of certain "genes" in the cells.

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the Companion-Work to his OUTLINE OF HISTORY

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H. G. Wells (who has always been interested in biology) studied at *Royal College of Science* under the great Thos. Huxley — took his degree of Bachelor of Science at *London University* — taught Biology for five years.

His two collaborators were Julian Huxley, grandson of Thos. Huxley, and G. P. Wells, his own son. Mr. Huxley occupied the Chair of Zoology, *King's College*, and holds the Fullerian Chair of Physiology at *The Royal Institution*. G. P. Wells took First Honors in Natural Science at *Cambridge* and is an active teacher and research worker at *University College*, London.

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Our Readers Say

Here's a Kind Word for the Lowly Auto

I THINK J. S., St. Louis, Mo., is not as serious as he pretends. Surely one can show that the automobile has done more good than harm. Where would the United States be today if it were not for the auto or where would the world as a whole stand? The auto has helped solve the problem of the farmer and has opened up the remotest spot to progress and development. It has served as a stepping stone for other inventions as well. Yes, it causes deaths unnecessarily but that is the price we must pay for it. Instead of blaming the auto, I think the driver is mostly responsible. Am I not right? I hope he'll consider a little more carefully what he has to say. P. S. Now ain't that very rude of me to neglect my most important reason for writing, namely, to congratulate you on your magazine? The saying, "one will stand out" is true because on top of the pile you always find POPULAR SCIENCE MONTHLY ready and araring to climb higher.—R. L. B., West Point, Ga.

Patent Office Folks Human, After All

To "NEW YORKER" and other Patent Office lambasters. The Patent Office is doing you a great favor to put your stuff on record. Ninety percent of the patented things are junk; that's why they don't get over. How long would you want to look through the freak ideas now on record? How about a good patent attorney next time? I have some black eyes from the Patent Office myself. In one case it looks like a man's religion got in the way of my pet idea. Give the Patent Office credit for this one. Patent No. 1763415 Ap. filed Jan. 9th, 1930, patented June 10th, 1930. The Patent Office folks are human. Better work with them in a coöperative way. I have nothing patented yet that any one wants. How many have you?—E. B., Pine Bluff, Ark.

Can You Help Bill and John Dig?

I HAVE been a consistent reader of POPULAR SCIENCE MONTHLY for the past five years and have had a lot of fun working its problems. I have not found many as yet that have stuck me but here's one for you to concentrate on. John and Bill take a contract to dig a ditch 100 feet long for $100. One end of the ditch is hard digging and one end is soft digging, so Bill says he will do the hard end for $1.25 a foot if John will dig his end, which is soft, for seventy-five cents a foot. Therefore if each digs one foot they will draw $2.00 for the two feet. That will be $1.00 a foot will it not? The problem is how much of the ditch does each man have to dig to get his $50.—S. J. T., Orfordville, Wis.

Approved by the Wisdom of Age

I THANK you for the beautiful magazine you have built up and if I were a young man I should certainly continue with you. But on the last day of this year I was eighty-five years old and your monthly, which is indeed very fine, will have to be given up, along with several other monthlies and weeklies, because of the weight of years and the infirmities of the flesh. About all my reading now is in the Old Book which tells of the "house not made with hands, eternal in the heavens." May God bless and prosper you.—J. C. Y., Seattle, Wash.

Don't Blush, Tomboy; There's a String to It

LET THE fellows give a couple of cheers for "Tomboy," of Fort Myers, Fla. If more girls read POPULAR SCIENCE MONTHLY this would be a more useful generation. It is certainly a relief to discover a femme, these days, who knows the difference between a starter and a stuffing box, and who knows that a spark plug is something besides the name of a comic-strip horse. But don't get me wrong; I am not one of the advocates of the woman-taxi-driver idea, and I still cling to the notion that a woman's place is in the home. However, a little working knowledge of what makes the wheels go 'round in that home, and outside, is really a help, I think. Your magazine is great, and I am all for it, since it fills a big gap in the home mechanic's field. I like the boat construction articles, and would like to see more of them. An outboard constructed from your plans last year turned out fine, and we are now ready for something a little tougher. Why not a sailing dinghy, or something of the kind? They are plenty of fun to sail, and can easily be equipped with an outboard if desired. How about it? Something makes me feel perfectly sure that there are an awful lot of your readers, who constantly use your plans, who would be glad to get a chance at the dinghy.—G. T., Washington, D. C.

Admits that 700 Miles an Hour Seems Fast

ABOUT the first thing I saw in the January number of POPULAR SCIENCE MONTHLY was the new German "mystery" plane. In my opinion the mystery is for the builders to attain the anticipated speed of 700 miles per hour. The fastest speed to date is only a little over half of that. The English plane that made this speed was streamlined to the utmost and had the added factor of comparatively dense air for the propeller to grip. While the rarefied air at 35,000 feet cuts down the plane's resistance, it seems to me the propellers are going to have a tough time pulling that big plane along at even the present high rate of speed if they have nothing to grip. I am anxious for news of its trial flights if there ever are any. I think you have a great magazine.—H. L., Ocean City, N. J.

Here's An Idea for a Bike That Flies

YOUR article in a recent issue about the winged bicycle seems to me a very fine thing for giving young boys practical training and experience with aeronautics. But, while reading it, my mind wandered to the idea of gearing a small propeller to the rear wheel, and in this way it might be possible to soar some distance with the wheels off the ground. While I have no intention of tinkering with anything of this kind, I would like to see the idea put into the hands of the parties who are working with the winged bike.—J. K., San Luis Obispo, Calif.

Student of Occult Finds No Tricks

JUST a word in reference to the article in your January number on "Secrets of the Fortune Telling Racket," by Michel Mok. It has been my pleasure to meet personally several people, of a type usually quite modest and hence unknown to the general public, who do have what might be called supernatural powers of perception, and in all fairness to them, and to all others concerned, I hereby challenge anyone to explain just what "tricks" are used by them to obtain the "findings" they are capable of revealing. Why not let your readers hear both sides of the story, and let them decide for themselves whether or not everything is deception and fraud in the realms of occultism?—D. B. H., Houston, Texas.

High Altitude Flight Is All Figured Out

I THOROUGHLY enjoy your articles on aviation, especially those on the future of this great means of transportation. Some time ago I noticed an article in POPULAR SCIENCE MONTHLY saying a plane could reach a very high speed if it were about fourteen miles high, if it were not for the fact that the atmosphere at that elevation is too thin for the modern propeller. Isn't it possible for the plane to have a gear on the propeller so that it can be speeded up as the air grows thin? Also to cut down friction couldn't a plane have a propeller much too large for its motor and then have

"Stay home—and gargle with Listerine every 2 hours"

THAT is what your doctor would probably tell you to do if you had an ordinary cold or simple sore throat. Combined with rest and warmth, it is an excellent treatment. Over and over again this has been proved in the past 50 years.

These ailments are caused by germs multiplying by millions in the mouth and throat. They are continually striving to overcome the forces of health in your body. They often succeed when body resistance is lowered by such things as wet feet, fatigue, lack of exercise, exposure to draughts, cold, sudden changes of temperature.

Their names are Streptococcus Hemolyticus (the streptococcus germ), Staphylococcus Aureus (pus), and Bacillus Influenzae.

Reduces mouth germs 98%

And undiluted Listerine, used as a gargle, kills these germs—all germs—almost instantly. In 15 seconds to be exact—the fastest time science has been able to measure accurately.

Repeated tests, similar to those employed at great universities, show that it actually reduces the bacteria on the surfaces of the mouth 98%. And at the same time soothes and heals inflamed membrane.

As a precaution

As a precaution against colds and irritated throat, gargle with undiluted Listerine every morning and every night. And when these have actually gained a foothold, increase the gargle to once every 2 hours, meanwhile consulting your physician.

The wonderful thing about Listerine is that while a potent germicide, it is at the same time non-poisonous, safe to use, pleasant to taste, and healing to tissue. Keep Listerine in home and office and carry it when you travel. At the first symptom of trouble use it undiluted to get full germicidal effect. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

KILLS 200,000,000 GERMS IN 15 SECONDS—HEALS TISSUE

the motor geared down for use when taking off? When it reached a certain altitude the speed could be increased.—E. W. K., Blackwell, Texas.

Has Found a Cure for Hay-wire Blues

We would all go nuts if it weren't for Popular Science Monthly, which affords us good, high-class reading matter. The papers have all gone hay-wire over the political questions, murders, bank robberies, and other scandals. No articles compare with the inspiring ones in your magazine. Popular Science Monthly gives the poor, strained newspaper reader a chance to relax and recuperate only once a month. With the distressing increase of newspaper bunk, it looks as though you will have to send out extra editions to keep the world from going bugs.—R. M. C., Hesston, Kan.

Avoid a Headache and Use an Axe

Let someone explain how a saw cuts. For example: Let us assume we are cutting a thin piece of wood, one sixteenth inch thick, on a band saw. The first tooth that happens to strike it cuts down a thin shaving, just like a chisel, then we push the wood toward the saw into the space between the teeth until the next tooth comes and strikes it in the same way, cutting off another shaving. Simple, isn't it? But now let us assume we have a piece of lumber so thick that two or more teeth strike it at the same time. We would naturally think that the first tooth that strikes the thick piece would cut down a shaving as before; but there is no such first tooth, as several teeth must strike at the very same time, each tooth exactly following the path of the preceding one. What chance do we have to push the material into the saw? Or in other words, how can the teeth take a shaving?—F. H. L., Amana, Iowa.

From Cover to Cover Forever and Ever

I like every department in your magazine and hope you will not have to cut out any of them to make room for material that apparently some selfish subscribers are calling for. I especially like "Our Readers Say" and—well, all the others. My subscription soon expires, but rest assured that it will be renewed each year as long as I live so please don't stop sending Popular Science Monthly to me until some one notifies you I have left this old earth. Your series on the Patent Office was a wow!—P. E. M., Saranac Lake, N. Y.

Use the Scissors If You Don't Like It

I have been a regular reader of your magazine for several years and I can truthfully say that I have found no periodical equal to yours. The cranks who send their knock to "Our Readers Say" ought to get a good pair of shears and cut out the parts of Popular Science Monthly that they don't care for. But for me, give me all of it. Out here it's hard to get too much of a thoroughly good thing.—E. P., Bloomington, Ill.

Helicopter Doubters, Please Take Notice

In your "Our Readers Say" D. A. of Idaho has probably made a lot think of the helicopter. Not being in the know of the helicopter business I don't claim to be able to give the answer, but I think the following sounds fairly logical: Why should the whole fuselage of the helicopter, with its large area of resistance, especially that of the broadside of the rudder, revolve when the knifelike blades of the revolving wings offer so little resistance? The forward pull of the propeller ought to overcome this tendency of twirling, even though revolving at decreased speeds!—S. A. D., St. Petersburg, Fla.

Ice Age Swings from Pole to Pole

In the article on the Ice Age, by Charles Fitzhugh Talman, it is said that we are still in the Ice Age, but at the beginning of a minimum northern glacial winter. We are now at a period of minimum eccentricity of the earth's orbit, the sun being as nearly as possible equidistant from all points of the orbit. So there can only be a minimum glacial winter and a minimum glacial summer. Due to the precession of the equinoxes, the earth changes its position in its orbit till in about 6,000 years it makes the complete circle. The period from the maximum to maximum great glacial period is about 250,000 years. Thus every 250,000 years we have a great glacial winter and while we are enjoying the cool spell our friends in the southern hemisphere are enjoying a great glacial summer. During a northern great glacial summer, the North Polar basin would have only a lake in the lowest part, and animals and peoples would thrive there. With the coming of winter, they would be forced south. I hope I have made plain the fact that there was no universal Ice Age but ice periods alternately covering the northern and southern hemispheres.—L. B. W., Alpine, Calif.

Where in the World Did the Kick Go?

Here's a new problem your readers might think about—if any: A coiled-up metal spring is placed in acid. The acid dissolves the metal. What happened to the energy in the spring?—G. M., Martinez, Calif.

Calls Montgomery Father of Aviation

While in Europe I read your article about John Montgomery, who is, I believe, the real father of aviation. I know so much about his history and have spoken with so many who remember his early attempts that I often resented the silence that hung around his name and memory. I congratulate you on publishing such a fine article and thus rendering to John Montgomery some of the tribute he deserves.—R. R., San Francisco.

North Carolina Really Has Flexible Stone

In Popular Science Monthly recently there appeared an article entitled, "Exhibits Brazil's Flexible Stone." Flexible sandstone or itacolumite is to be found in North Carolina. Something like forty years ago I got specimens from a deposit in that state; some of these samples were upward of a foot long. Years ago itacolumite was used in the manufacture of sandsoap, the itacolumite forming the abrasive. I recall distinctly where I found this deposit and would have no great difficulty in locating it, if any one is interested.—E. M. W., Los Angeles, Calif.

Cry for Chemistry from the Far West

May I join with O. L. C. of Seattle, R. H. B. of Philadelphia, and J. D. F. of Carlisle, Pa., in requesting more articles on chemistry? I was particularly interested in the idea of chemical problems. To my knowledge this would be an original feature of your magazine. Chemical problems are, as a rule, interesting without being unnecessarily technical. They are also unique in the opportunity they offer for ingenious applications of commonly known facts. Popular Science Monthly is very enjoyable (especially to the friends who borrow my copy).—F. W. N., Spokane, Wash.

Short and Not What You'd Call—Sweet

You ought to change the name of your publication to Popular Tinkers and Model Makers Monthly. It's good for that but not much science in it.—O. O., Goshen, Ind.

Orders His Bracer to Follow Him South

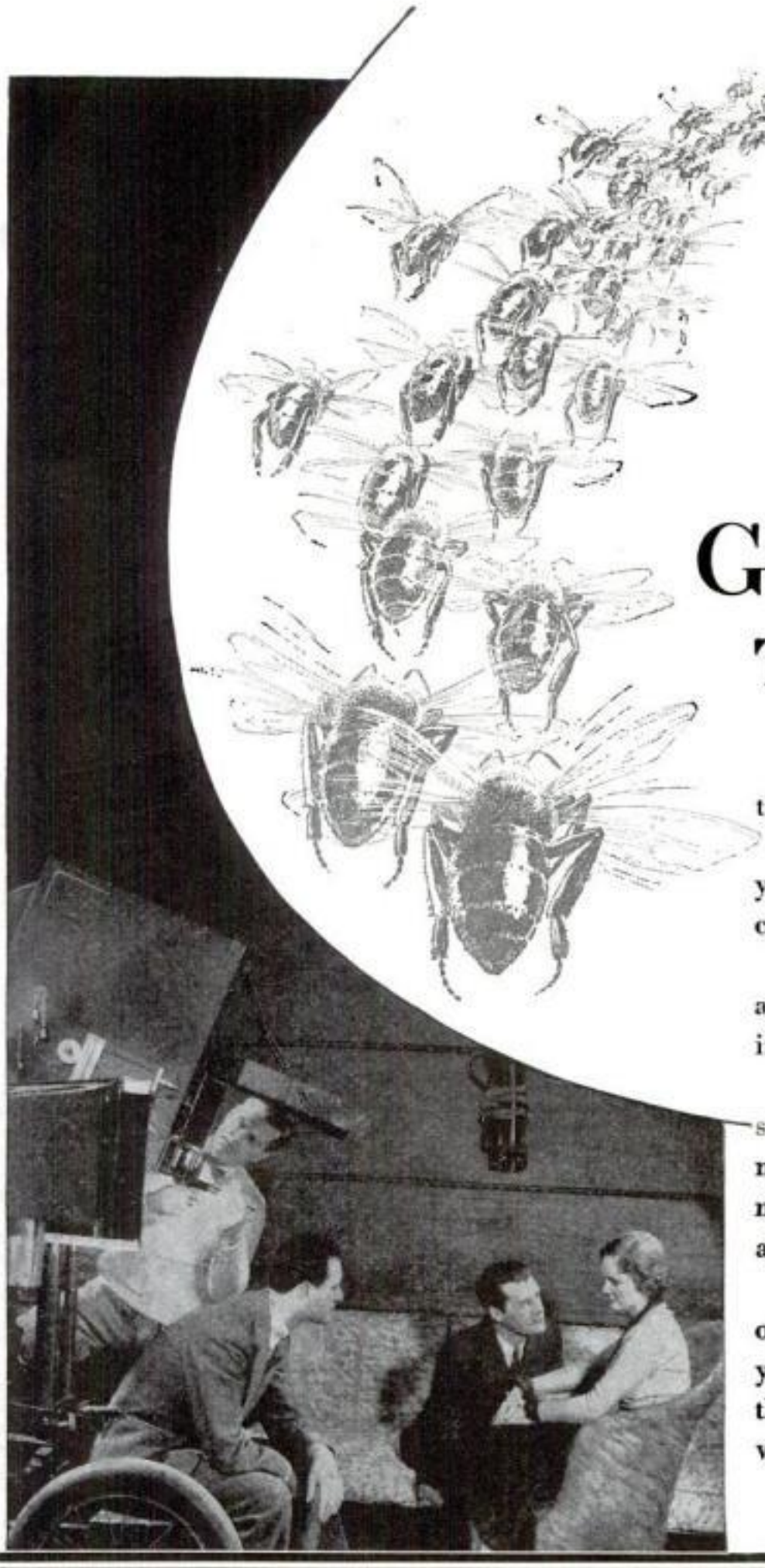
Would I be asking too much to have you send my magazine down here for four months? My health needed this move, so what do you say? You know I ordered some other magazines to stay up there, but Popular Science Monthly I've got to have for a bracer.—A. K., St. Petersburg, Fla.

Ignore the Croakers and Stay as Is

W. J. M., Macon, Ga., is evidently only a beginner in driving. Well, we must be somewhat lenient with the beginner, for we were all that at one time. However, for a great many of us, when we were beginners, there was little traffic on the highways. But he is all wet when he hits at the speed of the buses. Their equipment is always in as nearly perfect shape as good mechanics can keep it, and at the end of every run of several hundred miles they are thoroughly gone over and every part tested and the brakes inspected. Heavy as they are, and fast as they travel, the buses are not the menace on highways that ordinary cars are. I wish to congratulate the makers of Popular Science Monthly on the fine appearance of the magazine since the change in covers. You now have a cover that does credit to a fine interior. Pay no attention to the croakers.—E. B. M., Ventura, Calif.

All the Army Out of Step but Him

I want to tell you that I am just scientific enough not to swallow all the hablings of these self-exalted, so-called scientists. Their idiotic, wild guessing is laughable in the extreme. I don't want your magazine. I love truth but I don't go much on guesswork.—H. P., Black Eddy, Pa.



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March, 1931 · RAYMOND J. BROWN — *Editor* · Vol. 118 No. 3

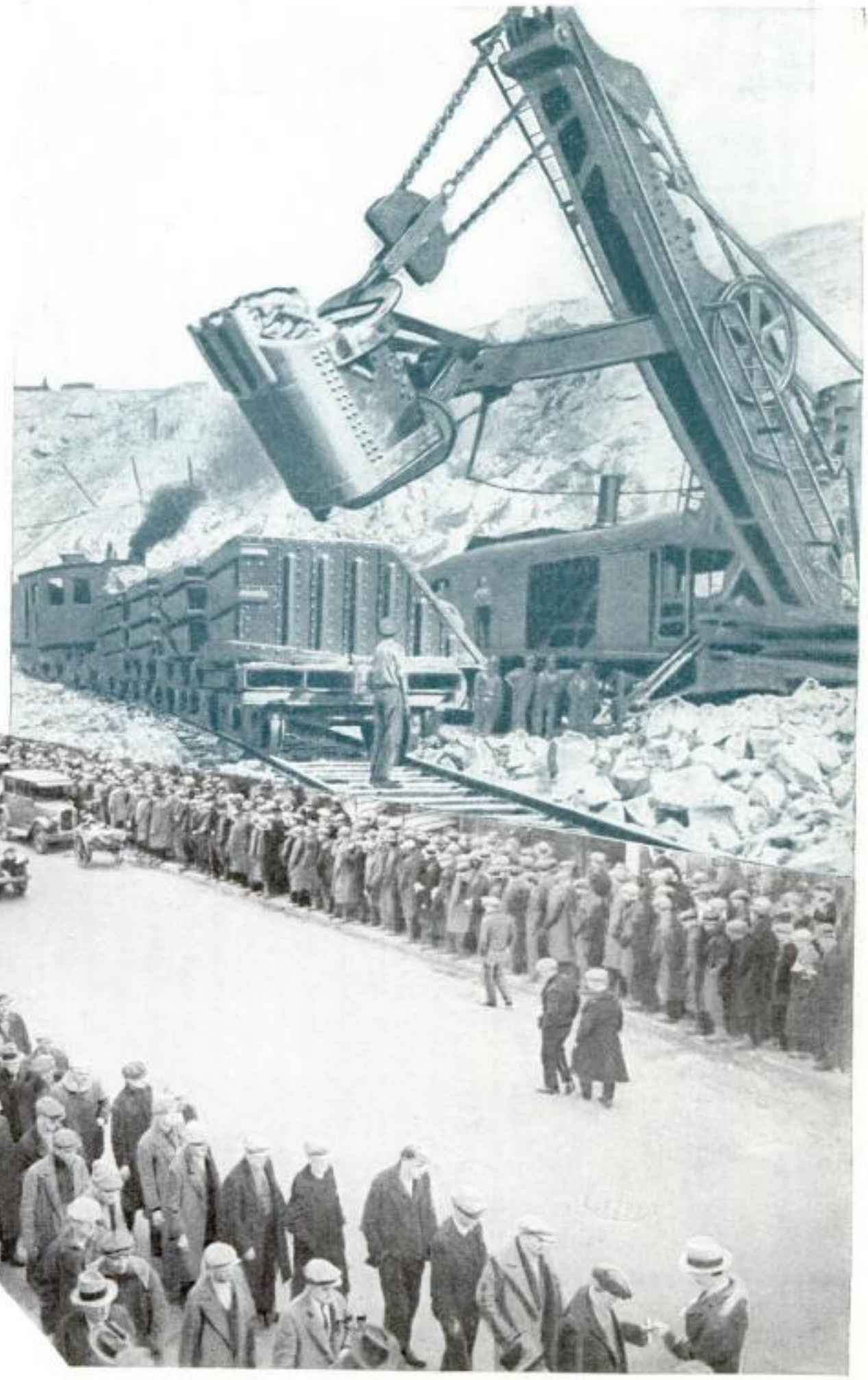
Will You Lose Your Job *Because of* A New Machine?

By
MICHEL MOK

AN ENGLISH watchmaker's apprentice named John Kay, in 1738, invented a flying shuttle for weaving cotton. This was the first modern labor-saving device and with its aid, one man could do the work of two.

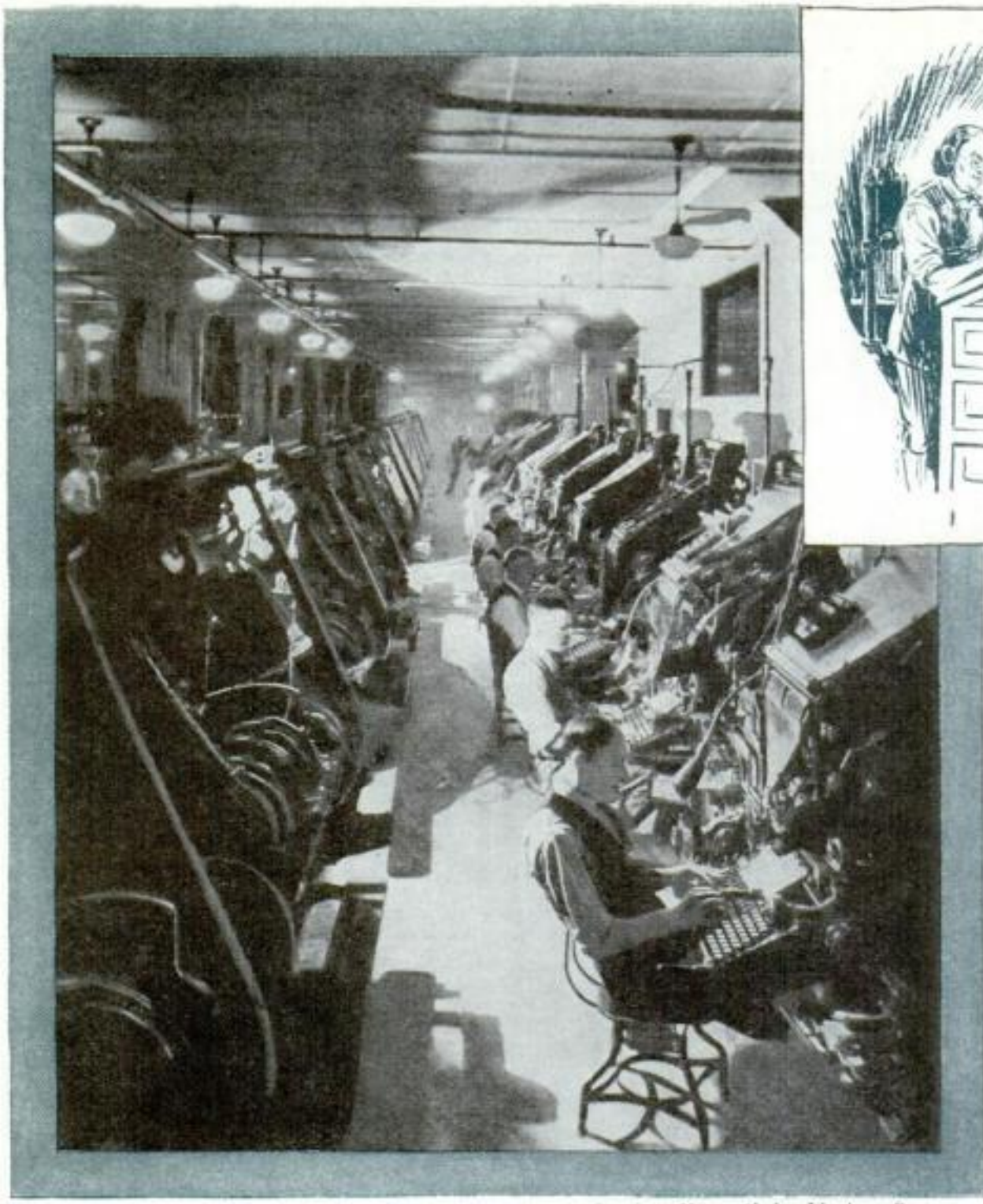
To the amazement of the young inventor, a roar of protest rose from the English weavers when it was introduced. Thirty years later, Kay aided in the development of a second labor-saving device, the spinning jenny. When this was installed in the English cotton factories, riots broke out.

An American manufacturer named Lloyd Raymond Smith, president of the A. O. Smith Corporation put into operation at Milwaukee, Wis., in 1920, an automatic plant for making automobile frames. His monstrous machinery turns out steel automobile frames at the rate of 10,000 per day—one every eight seconds of the day and night. Two hundred men do the work of 2,000. Only fifty of them actually touch the frames. Without doubt, the Smith plant is the most complete instance of the use of labor-saving methods to be found in the world.



Above, the big steam shovel doing the work of many men. At the right is a view of part of the unemployed men in New York City.

Almost 200 years have passed since Kay's flying shuttle infuriated the English weavers. During those two centuries the attitude of thousands of men and



Hand compositor could not meet present demands.

Courtesy Mergenthaler Linotype Co.

When this typesetting machine came in, thousands of hand printers were put out of work, but increased publishing business brought them back and added thousands of new ones.

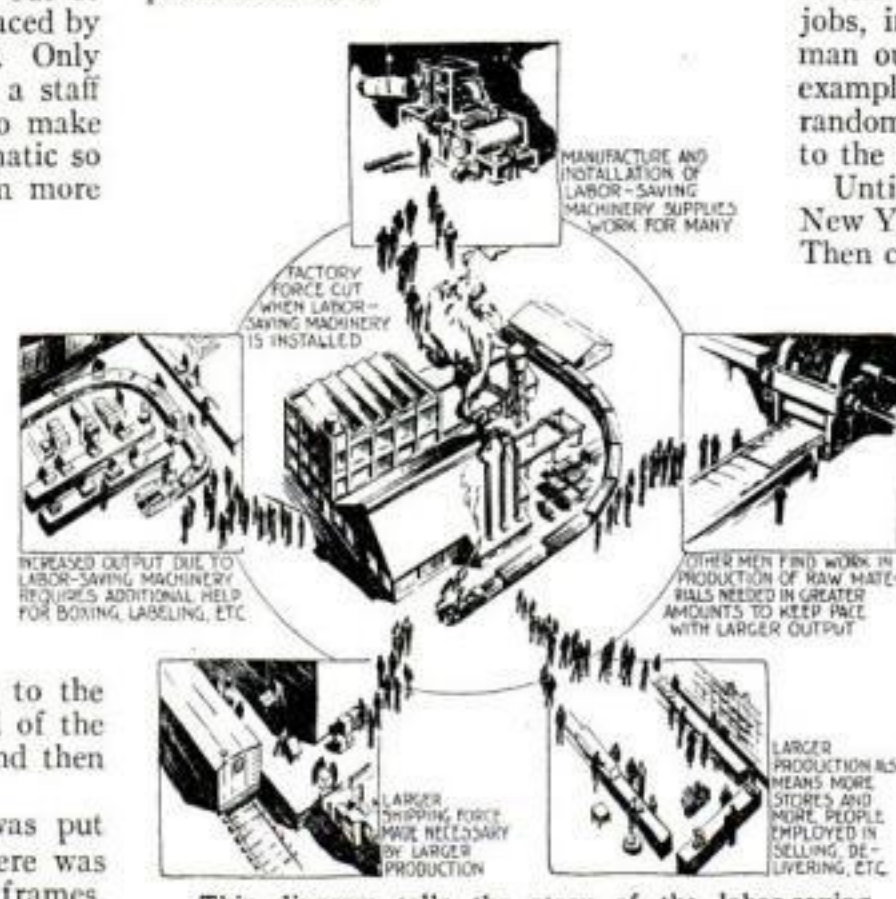
women toward labor-saving devices has not changed.

Time and again, the Smith plant is cited as a horrible example by those who believe that machines throw men out of work. Eighteen hundred men displaced by machinery in this one enterprise. Only 200 mechanics left at work while a staff of more than 600 engineers try to make machinery even more nearly automatic so that more jobs can be taken from more men!

ON THE face of it this looks like a final argument against the machine and justifies you in branding it as a man eater. But the fact is not a single man has lost his job in the Smith plant because of the new automatic machinery. On the contrary it has given work to many more men.

Eager to know if these statements given out as facts were really true I put the problem up to the A. O. Smith Company. An official of the company told me they are true and then gave me this explanation:

"The automatic frame plant was put into operation at a time when there was a large increase in the demand for frames. We, therefore, kept all of the men in the old 'hand' plant and employed new men for the automatic plant. We still operate the old plant for the 'small runs,' and use the automatic plant for the large quantity production runs."



This diagram tells the story of the labor-saving machine and why it does not keep men out of work.

That's part of the story. The rest, still more surprising, shows how even more men were put to work. Research by the same staff of 600 engineers that seemed bent on kicking men out of jobs led to a new electric arc welding process which, applied to couplings for joints in oil well pipes, has supplied jobs, directly and indirectly, for more than 5,000 men! In short, the Smith research gang robbed not one man of work but literally put thousands of new ones on the pay roll.

Today, the new Smith pipe plants turn out thirty-two miles of pipe, ranging from four to twenty-four inches in diameter, every day in the week. In two months, last spring, orders came in for 4,000 miles of pipe in the laying of which an army of men is still employed.

BECAUSE of the undreamed-of low prices made possible by labor-saving machinery and mass production, gas now is piped 1,250 miles from Texas to Chicago; from Amarillo, Tex., to Denver, Col., 375 miles; from the Monroe field of Louisiana to St. Louis, Mo., 431 miles; from Kettleman Hills, Calif., to San Francisco, 190 miles (P. S. M., Aug. '30, p. 23).

All of this seemed like a wild fairy tale and I again appealed to the Smith Company official for an explanation.

"That's right," he said. "When the pipe plant was ready for operation, additional men were employed. Therefore, we have a great many more employees on our pay roll today than before the automatic frame plant was started and before we began the manufacture of pipe."

The Smith plant is only one of many in which labor-saving devices have made jobs, increased the pay roll, and put no man out of work. For instance, here are examples, not hand-picked but chosen at random, and anyone so inclined can add to the list without the least trouble:

Until a few years ago, all packing in a New York food factory was done by hand. Then came a "stacker" that did the packing mechanically, and with its installation more than 1,000 men lost their jobs. But the new packing method so speeded up distribution that all of the old men were taken back and put to work on finishing and labeling.

A New England screw factory installed new automatic screw makers, a number of which could be cared for by one man. Out of 600 men previously employed, 200 were dropped from the pay roll. But the new machines increased production, an official of the company told me, lowered prices, and so stimulated the demand that every one of the

old employees had to be taken back to pack, count, and weigh.

In the case of the Smith plant, machines made new jobs. The other labor-saving devices were responsible, first, for the loss of old jobs, and second, for the creation of new ones so that the number of employees remained the same or was increased.

TODAY millions of men, able, anxious to work, are out of jobs. They see a machine doing the work of a hundred, a thousand men, and they blame it for their idleness and suffering. But all over the world men are out of work; they are idle and hungry in the countries where the machine is not developed, where handwork is still the main source of production.

These facts must mean something, and those who claim to know, who have made a study of the ups and downs of trade, say the millions are jobless today because of economic conditions with which the machine has nothing to do. These wise ones blame over-production of crude products like coffee, sugar, etc.

Still others will always blame the machine as being the thing handiest to kick. Am I wrong then when I pat the machine on its shining back and cite instances to show that it makes jobs instead of ending them? If you think so, imagine trying to meet the demands of Chicago, New York, London, Paris with handmade, hand-packed, hand-transported produce! Could it be done? Could civilization, as you know it today, carry on without the machine? Where then are you going to set a limit and say up to this point the machine is good and beyond it it's bad?

To banish labor-saving devices would deal a death blow to all machinery. For the same type of mind, the same kind of research, that creates labor-saving machines also produce the thousand-and-one devices that do not save labor and that have become indispensable to our civilization.

Take, just as one example, the late Elmer A. Sperry. Back in 1888, he invented the first electric chain mining machine, a labor-saving device if ever there was one. But since then he also has given us the gyro-compass and the airplane and ship stabilizer, now absolute necessities to navigation and aviation.

THROTTLING invention and research, suppose it were possible, would be one of the worst calamities that could befall mankind. Picture, for a moment, a world without electric light, without automobiles, airplanes, steam engines, tractors, telephones, telegraph, radio, moving pictures, cranes, elevators, typewriters, the X-ray, and modern surgical instruments, to name but a few. These and countless other inventions and mechanical developments have contributed to the comfort, happiness, and health of the human race. Also, don't forget they have given jobs to millions of workers.

The automobile itself—especially the truck—is a labor-saving device. It has done away with untold drudgery by men and horses. When its use first became widespread, numbers of men, such as blacksmiths, wagoners, wheelwrights, saddlemakers, lost their jobs. But since then, it has given work to a huge army of men.

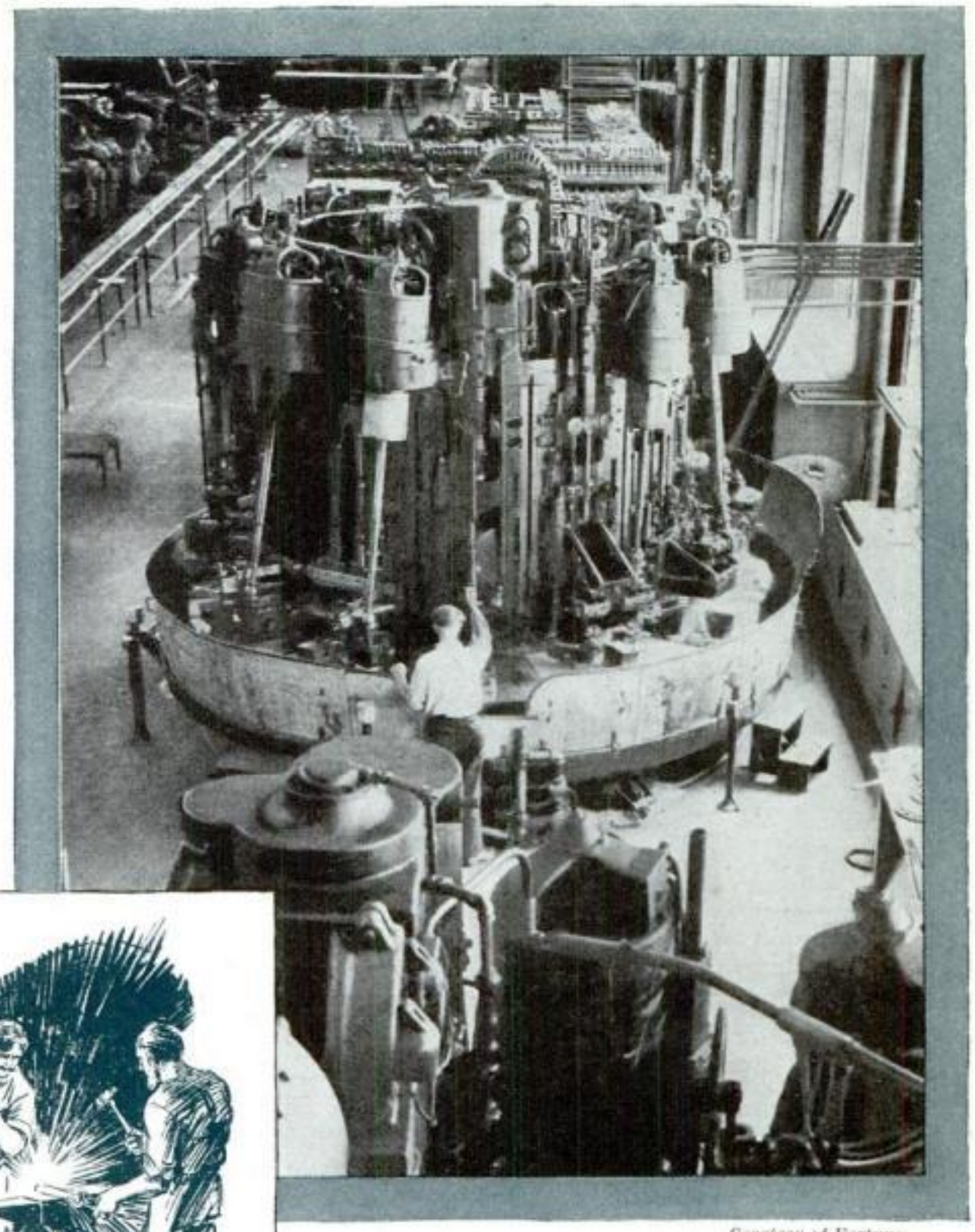
When a machine puts these hand workers out of work they will get jobs in other lines.

The National Industrial Conference Board has no axe to grind. It wants facts, truth, and maintains a bureau of research for the purpose of finding out what's what in industry. Dr. Magnus W. Alexander is president of this Board, which probably knows more about what's going on in the factories and distributing plants of the world than any other existing organization.

"IS IT true," I asked Dr. Alexander, "that machines put men out of jobs and by so doing take the food out of their mouths?"

His reply was an emphatic "No." The idea that improved machines mean fewer jobs, he told me, has been proved false by an extensive survey made by his organization.

Naturally, he said, the use of labor-saving machinery means fewer men for the production of a given quantity of goods. But labor-saving machinery has built up and expanded the machine-building industries as well as lowering production costs. The net result is not only lower prices, but also higher wages.



Courtesy of Fortune.

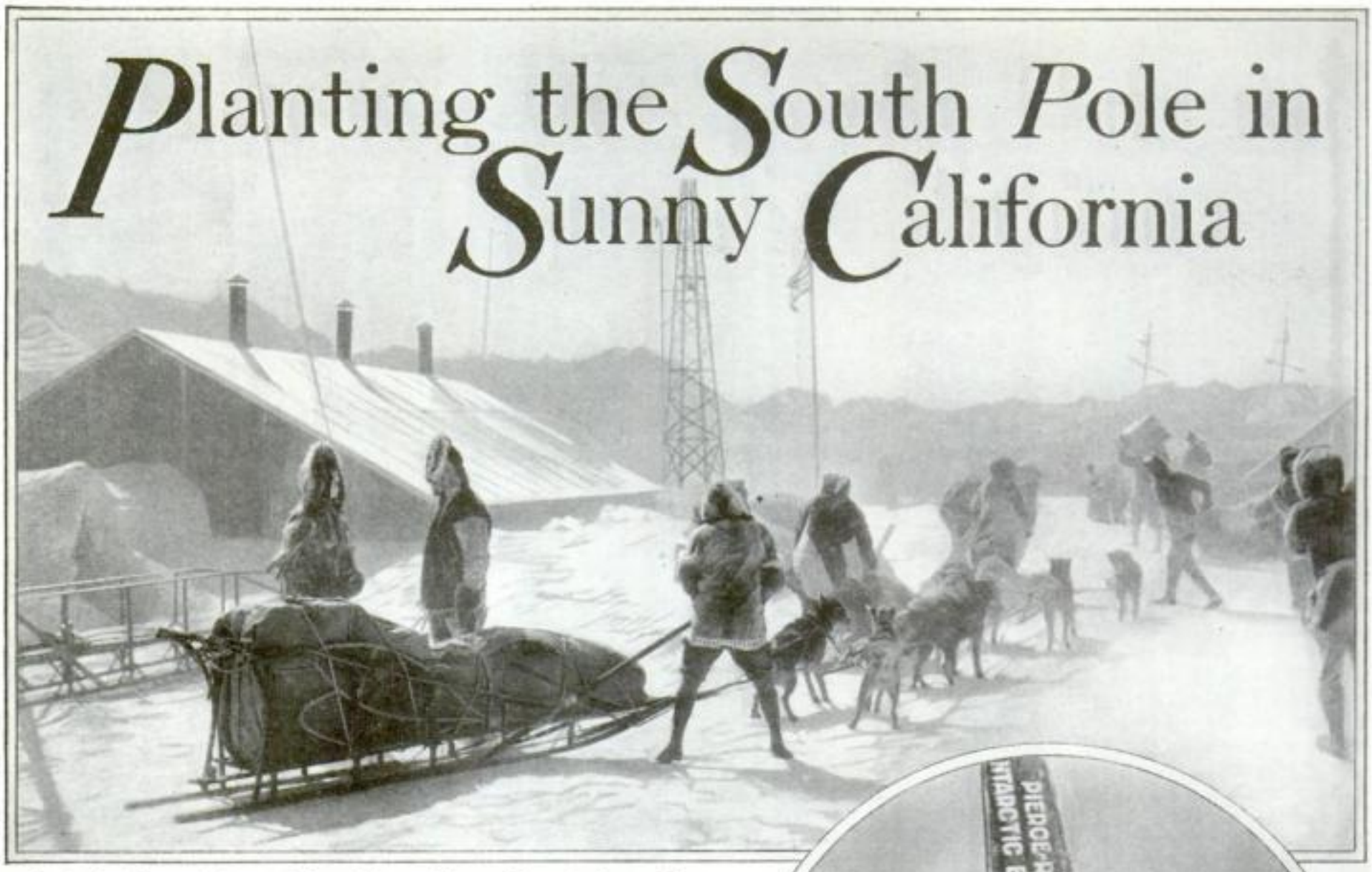
This machine, automatically making auto frames, does the work of 1,800 men, and yet its installation did not cost one man his job.

ALSO, he explained, lower prices lead to a greater demand. For example, when automobiles were made so cheaply that you and I and thousands of others could afford to buy them, we got them. As a result, the men who were thrown out by labor-saving machinery were rehired, often along with many others, in an effort to make the output meet the demand.

Few industries are self-supporting. More automobiles mean more rubber, more upholstery fabrics, more glass, more steel, and more of other raw materials and articles. This increase all down the line makes jobs for many additional men. Meanwhile, higher wages increase the national purchasing power. That means more business, more work—an endless chain.

Also this greater volume of goods must be distributed. Thus, again thousands of new jobs are created. In the case of articles like the automobile, thousands of men are needed *(Continued on page 136)*

Planting the South Pole in Sunny California



In the howling gale from wind machines, raising a blizzard of corn flakes, the dogs, in California, prepare to mush on across waste of gypsum snow.

In This Unusual Article You Are Told How Frigid Wastes of Ice and Snow Are Skillfully Reproduced

By ANDREW R. BOONE

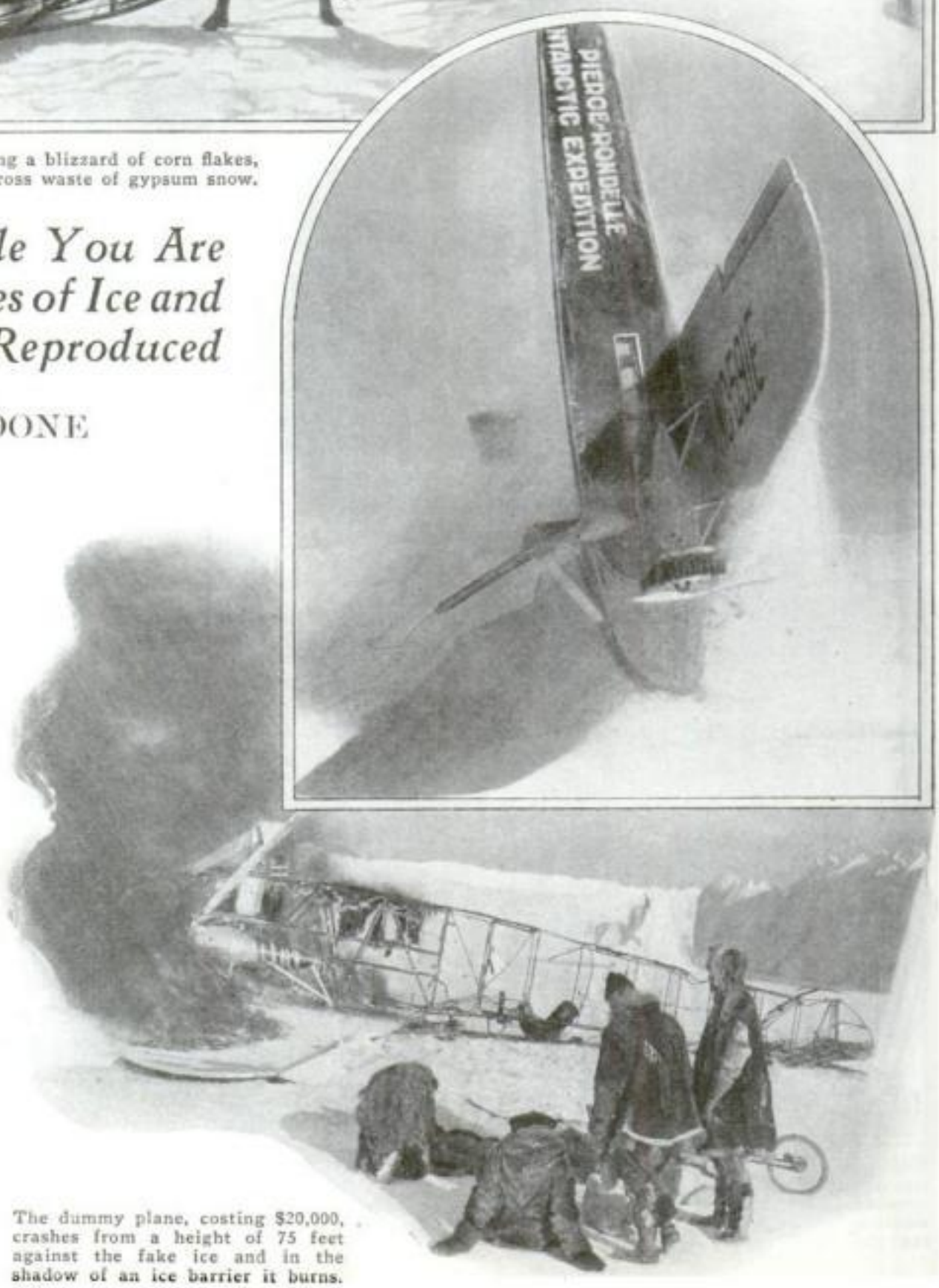
BRINGING the frozen South Pole to California is one of the latest achievements of the motion picture industry. The amazingly realistic photographs on these two pages indicate how successfully it was done.

Frigid Antarctic scenes which will be shown in a picture this spring were shot in a southern California valley, while actors in heavy furs and stage carpenters in bathing suits mingled behind the cameras.

Scenes showing a huge dirigible crashing in the Caribbean Sea and airplanes "cracking up" in Little America and at the South Pole were shot in movie-made storms near Los Angeles.

In two days a crew of movie carpenters rebuilt a 250-foot dirigible, broken in two by a heavy wind. On Monday night, after the storm of Saturday, the new dirigible—a skeleton covered with canvas—was filmed, and the cameras recorded a section of the big ship floundering in the waves that were tossed against it by rain and wind and wave machines.

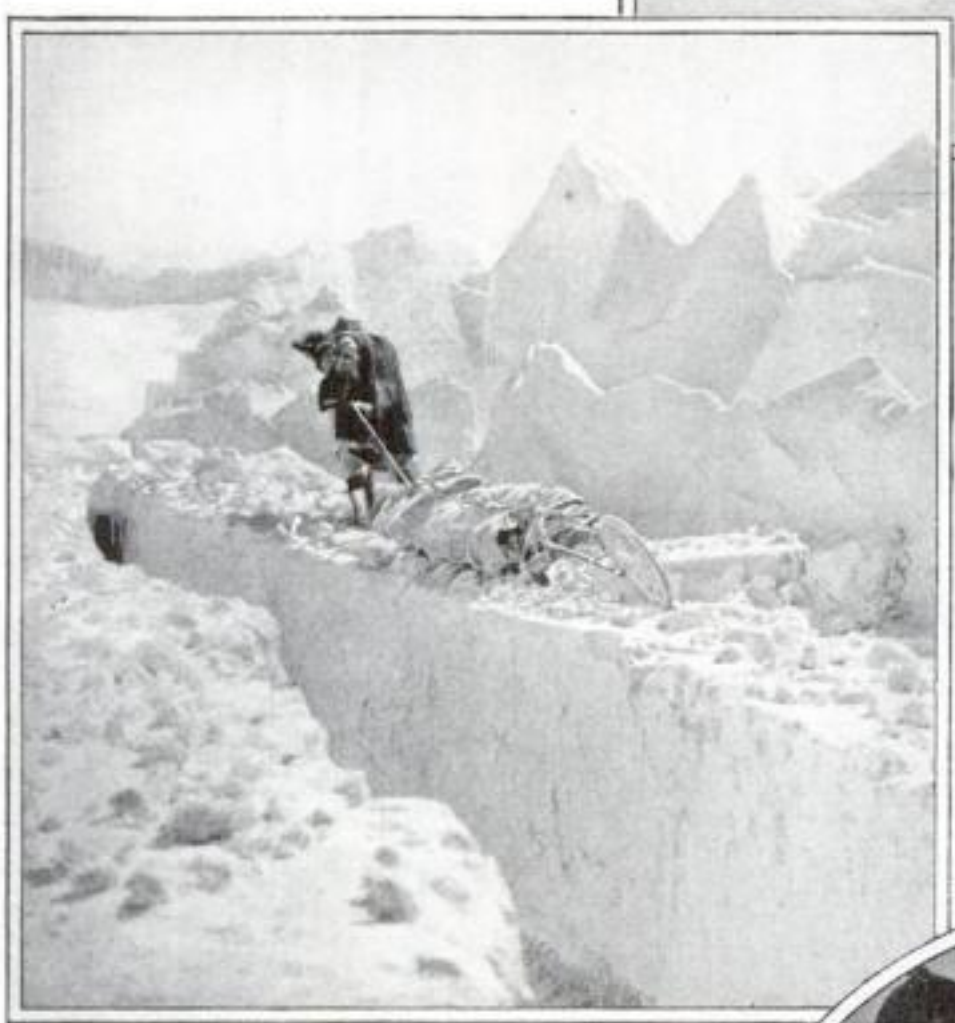
Part of the action shows actors inside the dirigible after its beams had collapsed. The interior duplicates the Navy dirigible *Los Angeles*, but the trusses and beams were made *(Continued on page 150)*



The dummy plane, costing $20,000, crashes from a height of 75 feet against the fake ice and in the shadow of an ice barrier it burns.

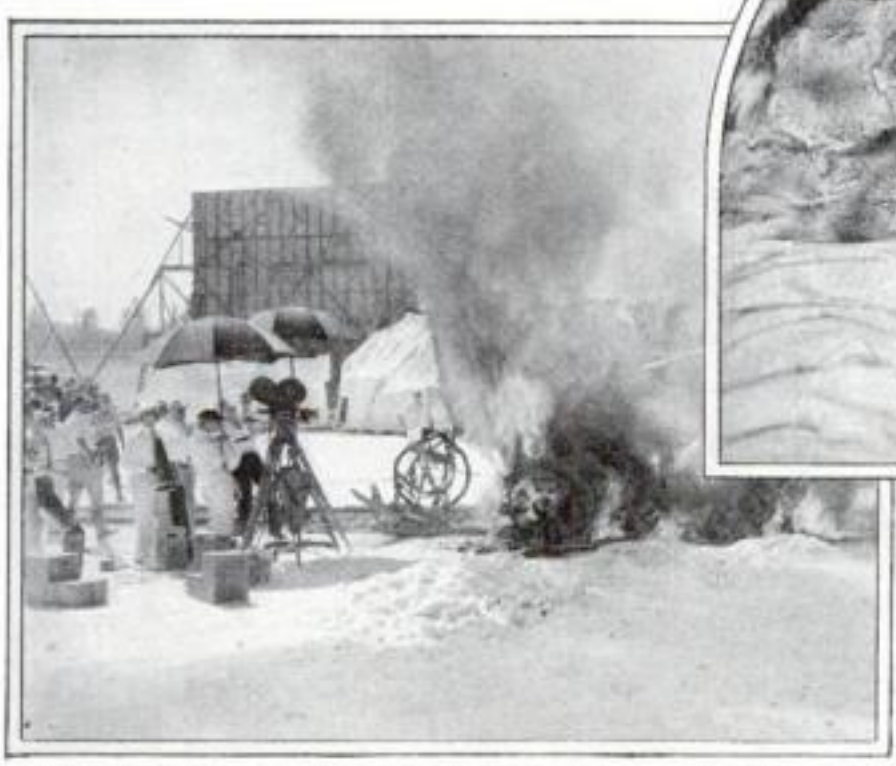
This lifelike figure of wax lies frozen in Polar ice of gypsum. Water pipe provides the cross at its head.

A whirling storm of bleached corn flakes enveloped the actors as they got the dummy plane ready for its spectacular dash toward the Pole.



Swaying and cracking icebergs of wood, canvas, and plaster sang their song of death for the sound film while actors robed in furs crawled along the crevasse.

Rescued from freezing—in the California sunshine. The ropes descend from the dirigible which rushed to the Antarctic to save the aviators whose plane crashed in a daring effort to fly over the South Pole.



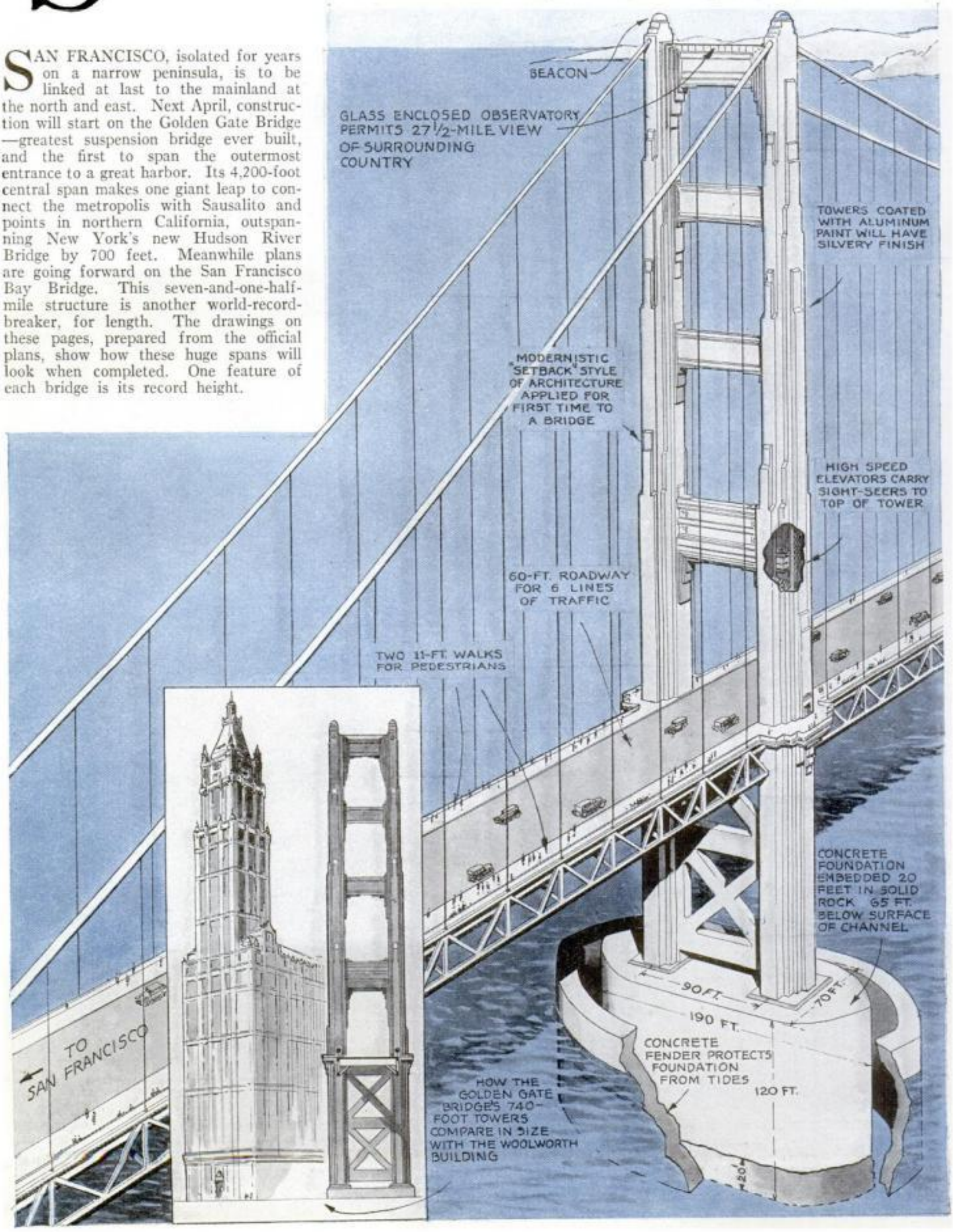
While this plane, in the heart of the frozen Antarctic, burned for the camera, directors and actors in shirt sleeves and white trousers sheltered themselves from the fierce rays of the hot California sun beneath umbrellas.

Robed in furs, actors dished food from this combination heating and cooking stove and were driven nearly frantic by the heat while the scene was recorded on film.

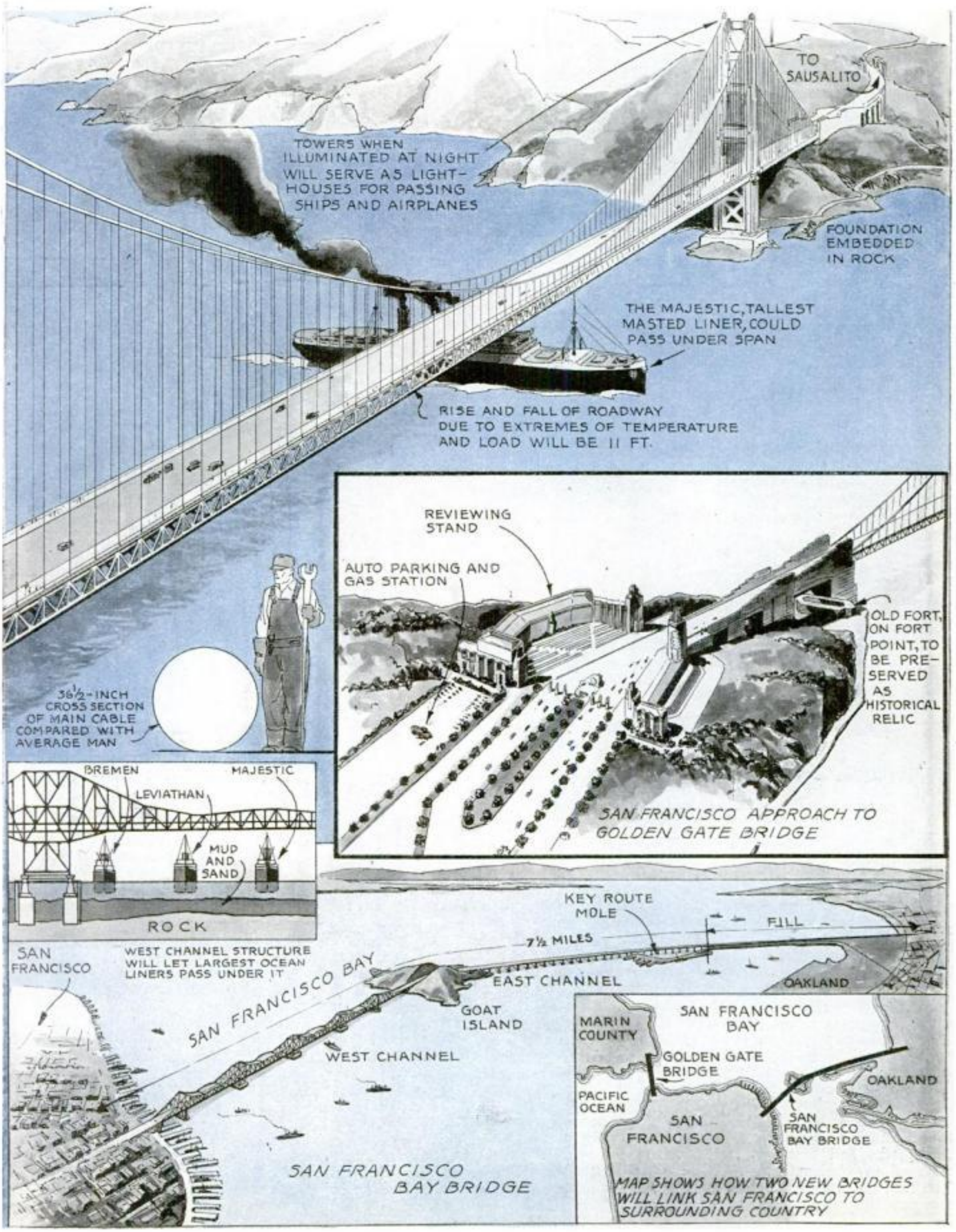
At right, the California ice scene with nothing faked—except the ice. Real clouds formed the background for this picture of desolation.

San Francisco to Have

SAN FRANCISCO, isolated for years on a narrow peninsula, is to be linked at last to the mainland at the north and east. Next April, construction will start on the Golden Gate Bridge —greatest suspension bridge ever built, and the first to span the outermost entrance to a great harbor. Its 4,200-foot central span makes one giant leap to connect the metropolis with Sausalito and points in northern California, outspanning New York's new Hudson River Bridge by 700 feet. Meanwhile plans are going forward on the San Francisco Bay Bridge. This seven-and-one-half-mile structure is another world-record-breaker, for length. The drawings on these pages, prepared from the official plans, show how these huge spans will look when completed. One feature of each bridge is its record height.



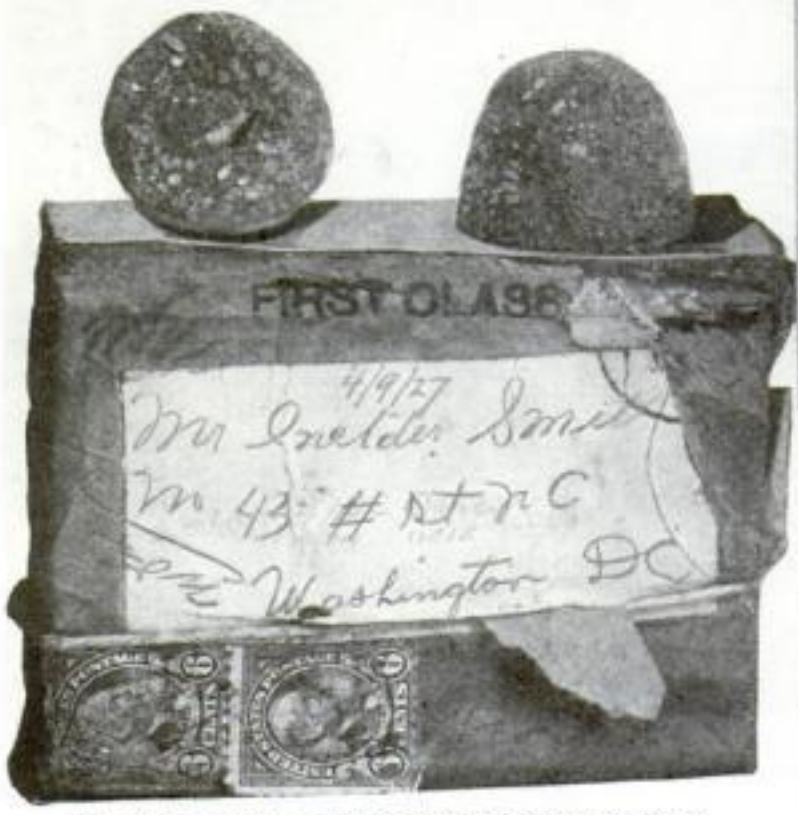
World's Greatest Bridges



Science Is *Bloodhound* at Heels of Forger

Chemist and Handwriting Expert Is Sherlock Holmes in War to End Frauds That Cost $150,000,000 a Year

By EDWIN W. TEALE



Note the phantom letters behind address on card that helped solve strange poison gumdrop case.

Bert C. Farrar, U. S. Treasury forgery expert, examining a doubtful paper with light shining up through a ground glass to see if signature has been traced.

FORGERY is on the increase. According to William B. Joyce, chairman of the National Surety Company, of New York City, this crime is mounting due to present business conditions. The yearly loss from forgery in the United States is $150,000,000—a sum equal to the combined incomes of more than 70,000 average wage earners! In one recent week, the toll taken by forgers in a single eastern city was $300,000. The battle against the criminal penman has assumed new importance during the past fall and winter.

In this battle, handwriting experts, cameras, chemicals, and microscopes are used in the search for clues in the strokes and curves left by the criminal's pen. Some of the results are almost uncanny. For instance, witness a recent case in Pennsylvania:

Secret Service men who had been sent to Pittsburgh to take up the trail of a forger who had passed a large check, returned to Washington, D. C., baffled. The trail ended with the store clerk who received the worthless piece of paper. He had taken in fifty checks that day and was unable to recall anything about the man who had presented the forged one.

The operatives appealed to Bert C. Farrar, for thirty-eight years handwriting expert and examiner of questioned documents for the U. S. Treasury Department. Farrar studied the writing on the check carefully. Then he said to the operatives:

"Ask the clerk if a man about thirty-five years old, well educated and having a German accent, came to the store that day?"

They followed his advice. The clerk immediately shouted: "That's the man. I remember him now. He was the one that gave me the check!" The operatives trailed the forger to Ohio and placed him under arrest.

How did Farrar know that the forger was thirty-five, well educated and had a German accent? I asked him that question recently in Washington. For answer, he drew a chart from his desk, a chart upon which he has been working for years. It contains English words written by people of various countries and illustrates national traits in writing.

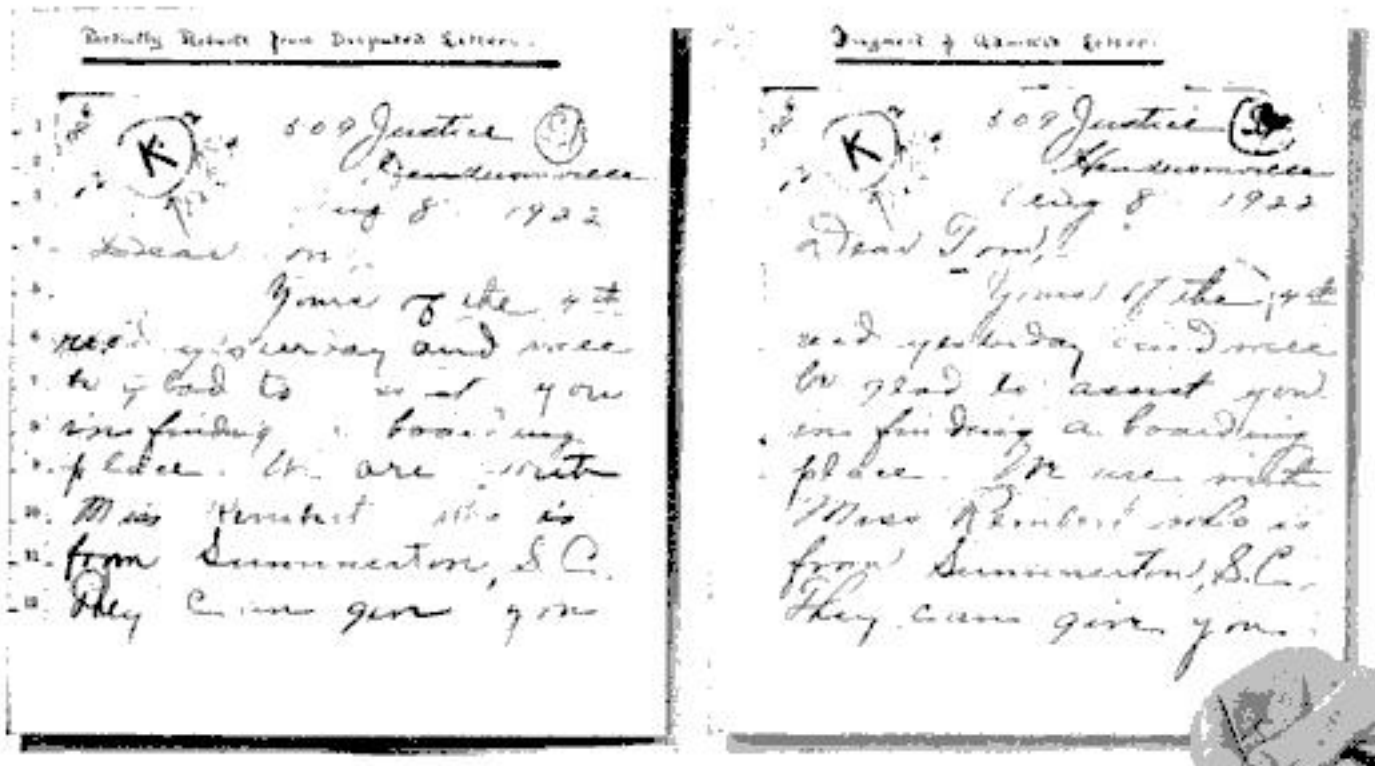
IN THE case of the Pittsburgh forger, a curiously-formed letter or two revealed to Farrar's expert eye that the penman had learned to write English in a German private school before the war. This showed he was of German birth, indicated he had had a good education, and suggested that his age, adding the elapsed time since the war started to the average age of private school boys before it began, was close to thirty-five.

Each year, between thirty and forty million checks pass through the Treasury Department in Washington. The daily flood sometimes reaches a high tide of 450,000. In spite of precautions, there are occasional fraudulent endorsements on these Government checks. Then Farrar's work begins. Last year, he traveled 40,000 miles testifying in court in connection with forgery cases of various kinds.

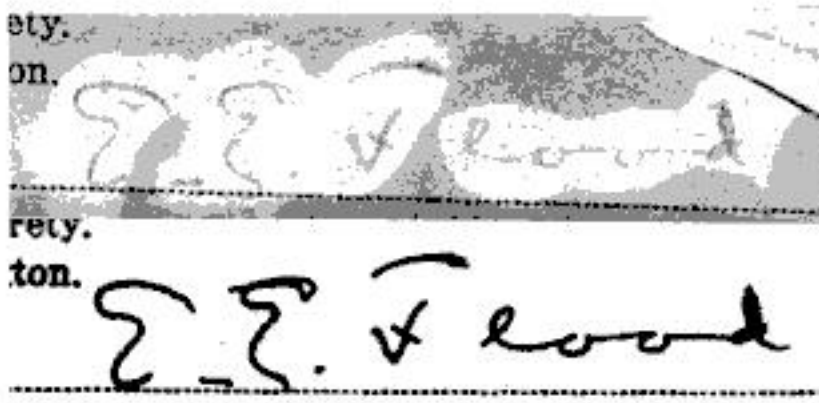
CONTRARY to general belief, only five percent of the checks which are criminally tampered with are "raised"; that is, altered to represent a higher sum than that originally placed upon them. Ninety-five percent changed for purposes of fraud are deliberately forged with false signatures or payee's endorsements.

Such forgeries are made by three types of criminals: the "Ground Glass Workers," the "Sketchmakers" and the "Free Hand Artists." The first places a valid check or a paper containing an original signature on a plate of ground glass under which a light is shining and traces the signature as a child traces a picture by holding it against a window pane.

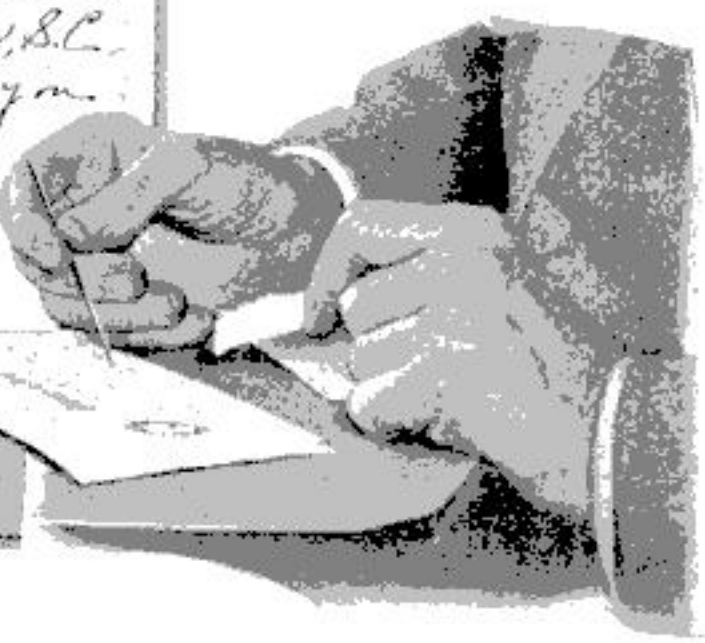
The second makes a "sketch" of the signature, frequently by rubbing lead from a pencil on the back of a check and then, by tracing over the signature, transferring a "carbon copy" of it to another piece of paper. When this "carbon copy" is traced over with ink the transfer is complete.



At left, rebuilt letter made of pieces cut from anonymous letters and used to prove the similarity of writing in them, and the admittedly genuine letter, shown at the right.



Chemicals brought the forgery to light in this case. At top the pencil signature is seen with the ink tracing removed.



Chemicals applied to signatures written with iron ink brings out traces of the original writing.

The most dangerous forger, however, is the one who obtains an original signature and then practices copying it until he can dash off an exact duplicate. Not long ago, Farrar asked one of these "Free Hand Artists" to write a name he had forged more than four months before. Without hesitating he produced an exact imitation of the real signature.

A traced signature can be detected almost instantly by an expert with a microscope. When a hand slowly follows an unfamiliar path, the line always wavers slightly. Instead of a clean-cut stroke, the result is ragged. To account for such wavering in traced signatures, ingenious excuses often are offered in court. Once, in a case in Montana, it was claimed that the signature had been made on horseback. Another time in a New York court it was alleged that the wavering letters had been penned in a taxicab rolling over an uneven pavement.

TRACED signatures often are detected by the attempts to erase the lead over which they have been traced. These erasures are visible under a microscope or when the check is placed on a ground glass against a light. In one of Farrar's cases, a tiny bit of lead under the ink of a signature proved that it was a "sketch." With chemicals, he removed the ink and revealed the carbon signature below.

Usually, Farrar told me, personal peculiarities that characterize a forger's own penmanship will appear in his attempts to imitate another's handwriting. In fact, according to this authority, it is almost impossible to disguise handwriting so the expert will be fooled. A fake medium was exposed by a handwriting expert who examined twenty slates upon which twenty different "spirits" were supposed to have written messages. The writing was the same in every case.

The fact that shading in writing is always made in toward the palm of the hand enables the expert with his magnifying glass to tell at a glance whether the writer is left- or right-handed. He can also determine the position in which the pen was held in relation to the body and between which fingers it was grasped. The general style of the writing will sometimes indicate the approximate age and origin of the writer as different styles have been taught in various schools at various times. The microscope in the hands of an expert also tells much about the kind of pen a forger uses.

For example, in Baltimore, some years ago, Farrar was able to testify in court that the forgeries on two checks presented the same day by the same man were made with different pens, one gold, the other steel. The crook confessed that he had written one with a fountain-pen on a street car and the other with the pen at the bank. The invisible iridium points soldered to the tip of a gold fountain-pen cause it to move smoothly over the paper, while the sharp point of a steel pen digs into the paper.

Farrar's chart shows influence of nationality on writing. This often gives valuable clues.

"AS BLACK as ink" is a simile that is good enough for ordinary use; but not for the handwriting expert. For him, there are a dozen shades of blackness, each telling its story. Over a period of years, Farrar and his assistants have been carrying on tests with all the well-known brands of ink, recording the chemical contents, color and other characteristics at different periods after they have been used in writing.

The reaction of a sample of ink to more than a dozen chemicals is noted at monthly intervals over a long period of years. One purpose of the test is to discover a means of judging the age of writing by the condition of the ink.

The two types of inks in general use are fugitive inks and iron inks. The former can be so completely removed that they leave no trace. But the iron inks, which contain iron salts in suspension in hydrochloric acid, bite into the paper and leave some of the iron embedded in it. In time this writing turns reddish and fades, but by applying chemicals it can be restored. George Washington's will was written with this kind of ink and later restored in this manner. (Continued on page 149)

Will Autogiro *Banish* Present Plane?

By ASSEN JORDANOFF

At thirty miles an hour, the autogiro drifts lazily along far above the earth.

James Ray, right, explains to Jordanoff the mechanism of the new plane's windmill vanes.

Pulling out the knob on the instrument panel connects the vanes with the motor.

I HAVE just had the biggest thrill of my twenty years of flying. I have piloted an autogiro. And I have seen this amazing windmill plane "do the impossible."

It is, I am positive, the flying craft of the future.

At Pitcairn Field, fourteen miles from Philadelphia, Pa., James Ray, chief test pilot for the Pitcairn-Cierva Company, explained the design of the strange machine and took me for a passenger hop. We landed at the far side of the field. The spinning windmill over our heads slowed down. Its four yellow vanes, long and slender like blades of grass, drooped to a standstill above the bright green fuselage. Ray climbed from the rear cockpit.

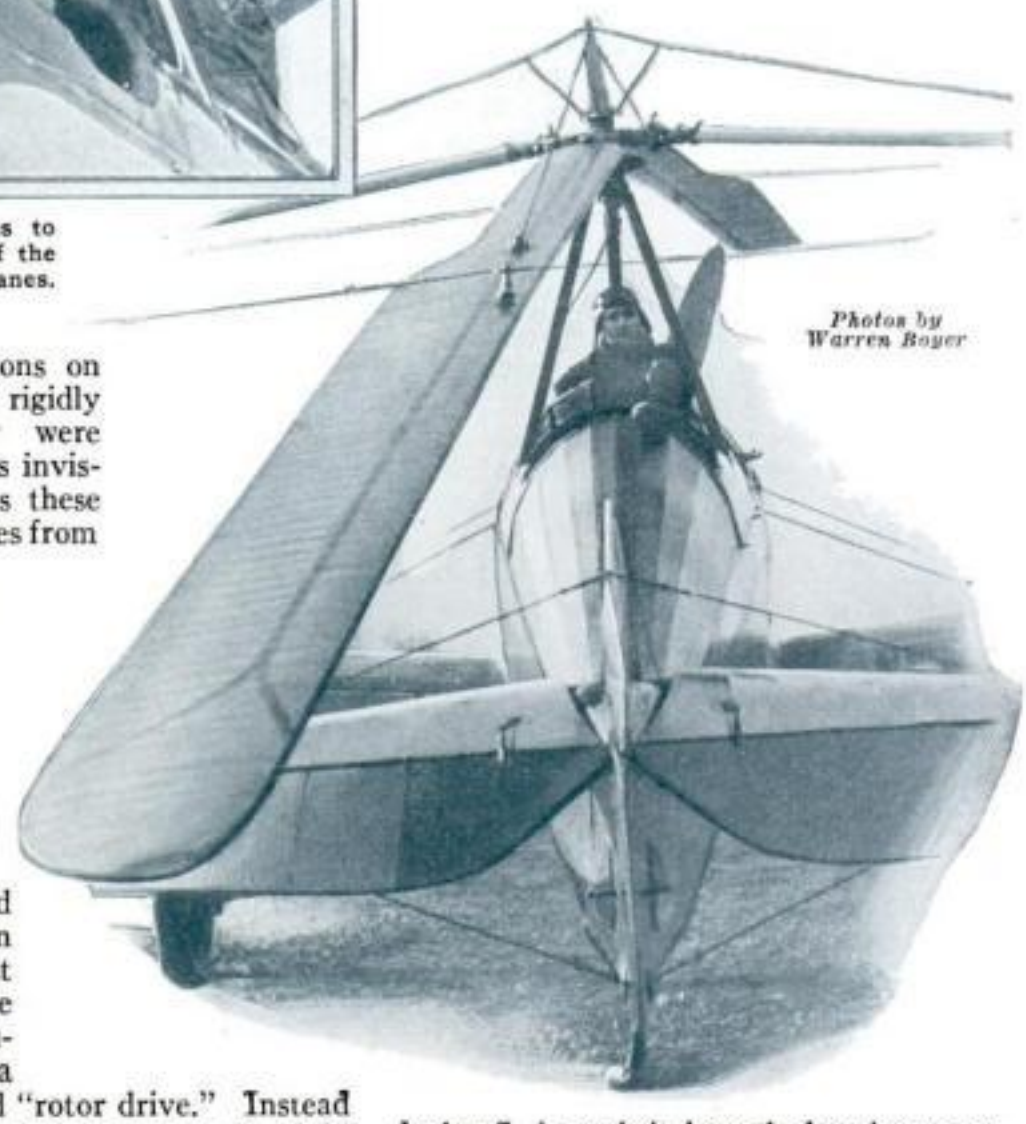
"All right," he said, "you can take her up now."

I settled into the pilot's cockpit and buckled the safety strap. Ahead of me, at the nose of the conventional fuselage, was a 225-horsepower Wright Whirlwind engine and its steel propeller. Beneath me was the small black stabilizing plane with ailerons and curiously uptilted ends. At the rear were the usual tail surfaces of an airplane. But above me was the striking feature of the strange machine.

At the top of a mast of three black steel tubes was the "rotor head" to which the long windmill, or rotor, vanes were attached. Each vane was free to move up and down. When the ton and a half mass of the machine is supported by these vanes there is nothing to keep them from "coning up," like an umbrella turned wrong-side-out—except centrifugal force!

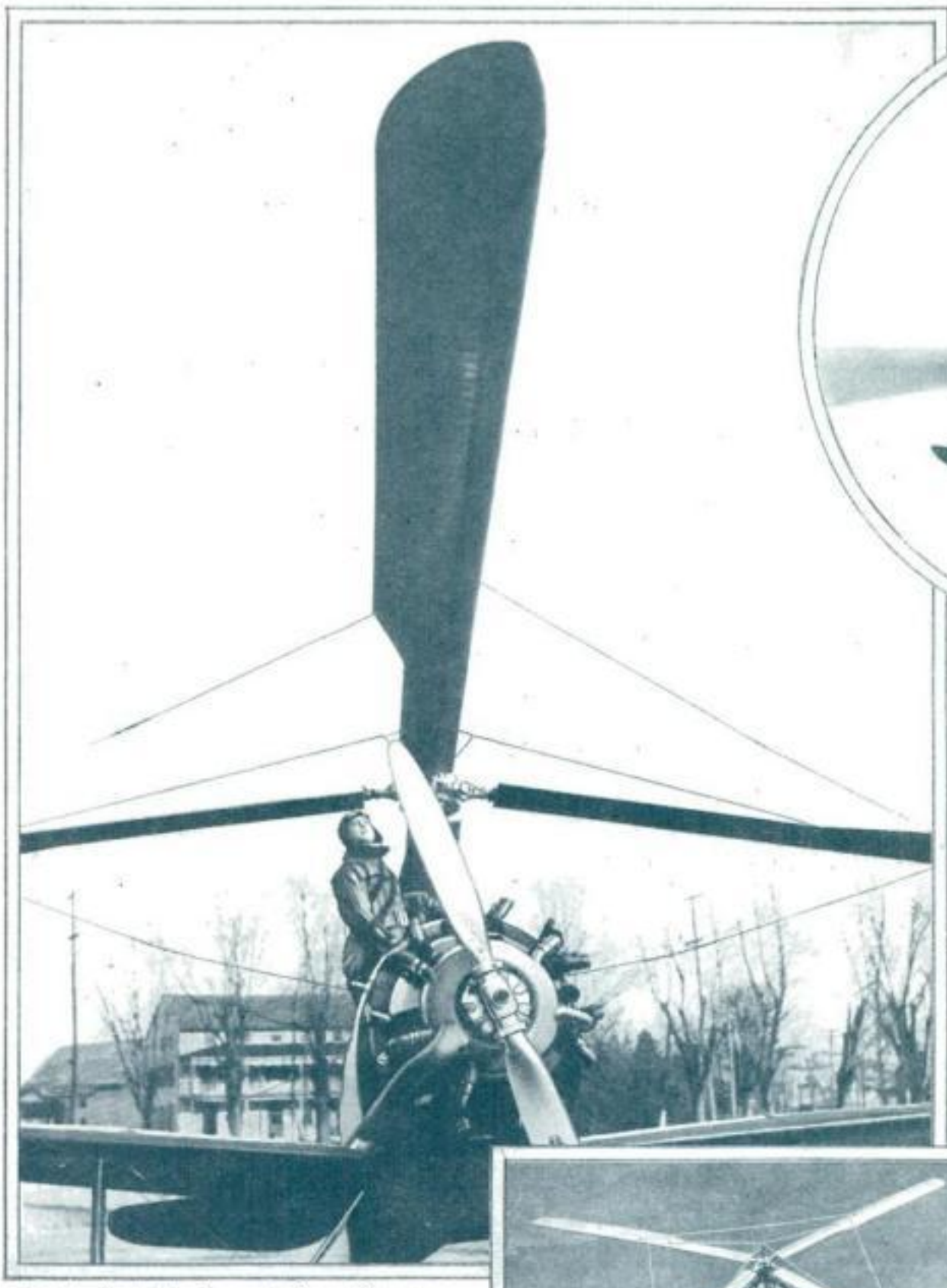
The only bracing wires on the windmill are small "droop wires" placed above the vanes to keep them from dropping to the ground and becoming damaged when at a standstill. In an autogiro, you "ride on centrifugal force." By the time the windmill is spinning at a hundred or more revolutions a minute, centrifugal force is stiffening out the vanes with a pull of more than two tons on every blade. As rigidly as though they were made of steel, this invisible bracing keeps these almost flimsy blades from folding upward.

Ray pointed to a small lever at the right of the instrument board marked "rotor brake." That, he explained, holds the windmill from being turned by the breeze when the machine is at rest. Below the center of the instrument panel was a large knob labeled "rotor drive." Instead of taxiing back and forth across the field to get the rotor spinning, the Pitcairn machines are equipped with a drive shaft

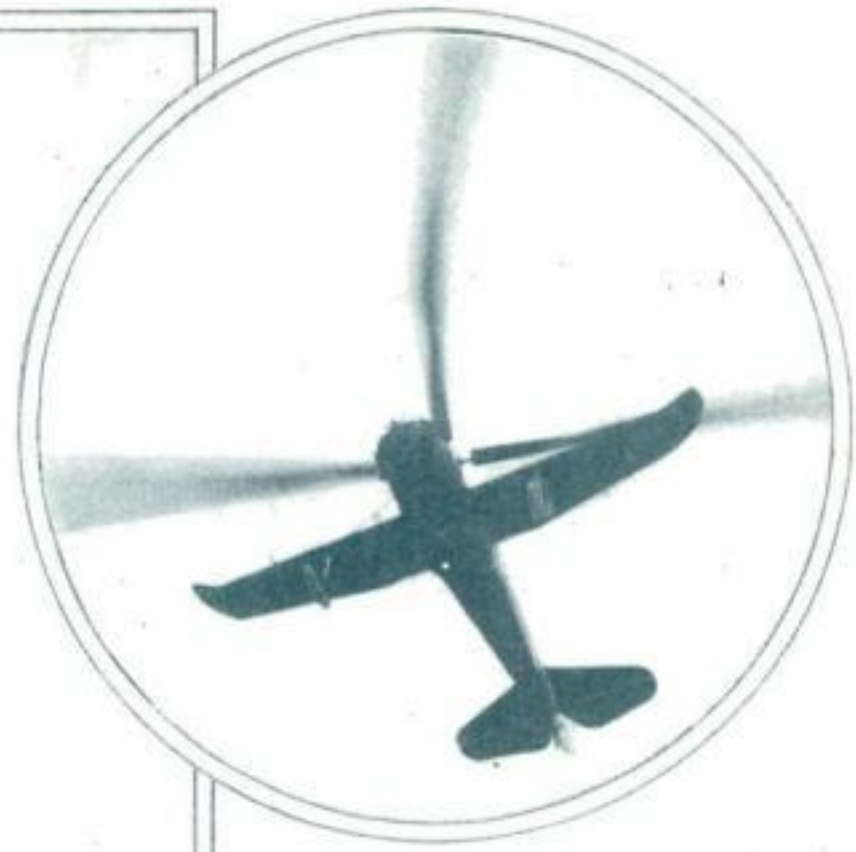


Photos by Warren Boyer

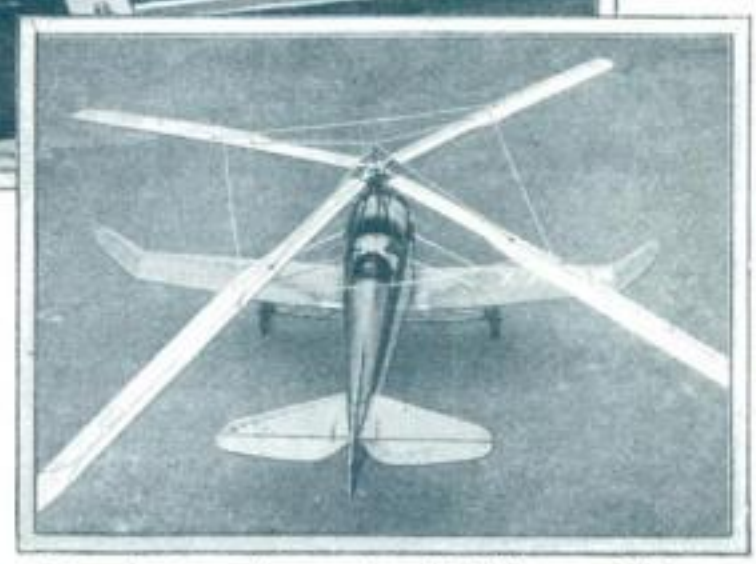
Jordanoff, in cockpit beneath drooping vanes, ready for his first autogiro flight. The autogiro, except for the horizontal windmill vanes overhead, has the appearance of an ordinary plane.



Jordanoff studies the great, flimsy-like vanes, held rigid in flight by centrifugal force.



"I had hardly moved the stick," says Jordanoff, "to lift the tail, when the ship shot up."



The only brace wires on the windmill are small drop wires above the vanes to keep them off the ground.

from the engine, to save time. Pull out the knob and the drive is connected. Push it in and it is disconnected. In the air, the windmill is never operated by the engine. Its vanes are turned by the air rushing past them.

This brings up a common misconception. Many people think the autogiro is a form of helicopter; that its whirling windmill pulls it vertically upward. This is not true. Each vane is a separate airplane wing. It lifts, just as does the usual aircraft wing, by moving rapidly through the air. In the ordinary airplane, the amount of lift given by the supporting surface is entirely dependent upon the forward speed of the machine. Because the vanes of the autogiro turn at high speed, they continue to exert their lift even when the craft has come to a standstill.

With the Whirlwind idling, I pushed ahead on this lever, freeing the windmill. Then I pulled out the knob. The long vanes, extending far out beyond the nose and the tail of the fuselage, began to move. Directly above the knob on the instrument panel is a round-faced dial. It shows the revolutions per minute of the rotor. Between it and the engine tachometer, a white card gives the number of revolutions of the rotor at different engine speeds.

With my feet on the brake pedals, holding the landing gear wheels, I watched the two instruments. The needle of the engine tachometer advanced to 800. The merry-go-round above my head moved faster. The rotor tachometer showed it was turning sixty-three "revs" a minute. When the Whirlwind was turning 1,000, the rotor was making seventy-nine. The machine rocked and vibrated as the forty-eight-foot windmill speeded up. Faster and faster the reflections of the vanes raced across the glistening black surface of the stabilizing wing. On sunny days, Ray told me, the checkered light and shadow made by the whirling rotor sometimes distracts a pilot unfamiliar with the machine.

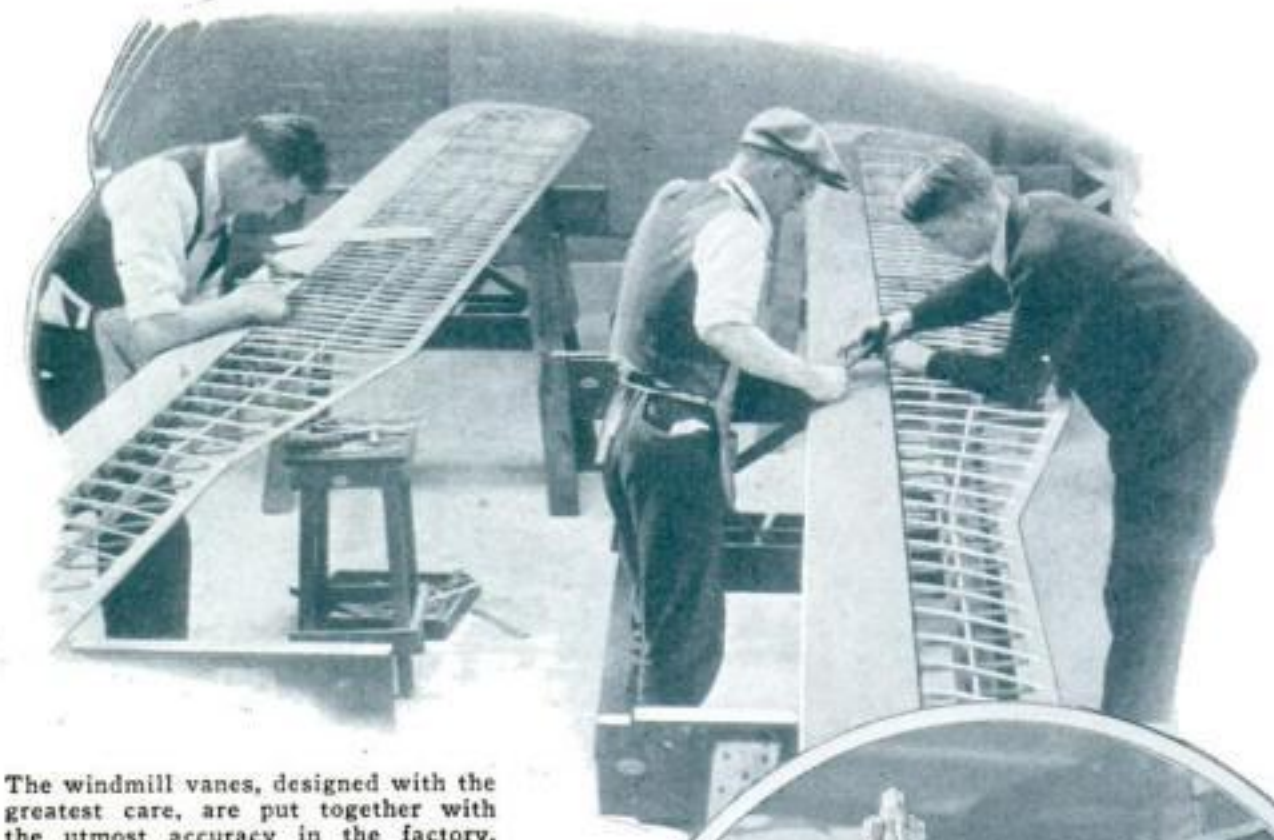
Now the whistling sound of the rotor was drowned in the roar of the whirlwind. It was bellowing at 1,500 revolutions a minute. The windmill was streaking around at 118. I was ready to take off.

I shoved in the knob of the rotor drive. Hereafter, the air striking the vanes would prevent them from slowing down. I slipped my feet from the brake pedals to the rudder pedals. The released ship raced down the field. I had hardly moved the stick to lift the tail when the ship seemed snatched into the air. An ordinary airplane runs several hundred feet before it takes off, often at a mile a minute speed. The autogiro gets off in less than thirty yards and takes to the air at twenty-five miles an hour.

I was climbing at a steep angle. The fact that an autogiro will take off at an angle from fifty to ninety percent steeper than an airplane has led it to be hailed as the "back yard plane" of the future. Any plot 400 feet square, I was told, will make a four-way flying field for a "windmill plane." Already, a five-passenger cabin autogiro is under construction in England for landing and taking off on roof tops and small plots in large cities.

For private owners, little machines with ten-foot vanes are entirely practicable, designed with vanes that fold together like the blades of a jackknife so the machine can be stored in an ordinary garage.

At an altitude of 600 feet, I leveled off. I had the queer sensation of flying a plane with the wings gone. I glanced upward. The vanes of the rotor were still milling around at dizzying speed. The air was bumpy, filled with up and down currents. But the flexible structure of the machine "ironed out" these ruts of sky travel. The vanes "give" just enough to cushion the drops. Only occasionally did I have to



The windmill vanes, designed with the greatest care, are put together with the utmost accuracy in the factory.

move the standard airplane controls by which the machine is guided. The plane almost flew itself.

I pulled back the stick and climbed to 1,200 feet. An autogiro's ceiling is around 20,000 feet; its high speed, over two miles a minute. Cierva, its inventor, is planning a racing autogiro which is expected to pass the 200-mile-an-hour mark. The "windmill craft" has withstood vertical dives at 140 miles an hour carrying 600 pounds of sand. It will do anything an airplane will do and, while these stunts have not been attempted yet, there is no aerodynamic reason, Ray told me, why they cannot loop the loop and fly upside down.

At the top of the quick climb, I got my only scare on the flight. I leveled off suddenly. I was watching the rotor tachometer at the moment and saw the needle drop back from 115 to 105. The rotor had lost ten revolutions. Was it slowing down? I shot a glance up at it. The vanes seemed turning slower and slower. But when I glanced back at the instrument the needle was back at 115 again.

Later, I learned that at the top of a fast climb, when the load on the vanes is suddenly lightened, they lose about ten revolutions. But as soon as the weight comes back on them again, they speed up. The greater the weight on the "windmill," the faster it turns. Tests have shown that there is no conceivable position in which the autogiro might be placed where the blades would cease revolving or slow down below the danger point.

I eased back the throttle. We drifted across the sky at thirty miles an hour. Rolling Pennsylvania hills, light brown winter fields, bluish orchards of leafless trees, spread out below. I gave the Whirlwind the gun and watched the air speed indicator hand creep ahead to 50-70-90-115 miles an hour. On a cross-country flight, the autogiro can maintain a cruising speed of ninety-five miles an hour. In a flight from Philadelphia to Chicago for the National Air Races last fall, Ray covered the 700 miles in six hours and forty minutes.

One after the other I tried skids, side slips, climbing turns, feeling out the machine. I found I had to press slightly harder on the rudder pedal to make a turn, but the stick control was more sensitive than on an ordinary plane. The ship made sharper turns at slower speeds than would be possible in the best of airplanes.

By now I was down to 800 feet. I nosed up slightly into the wind and eased back the throttle. The thunder of the Whirlwind sank away. The rustle and whistle of the spinning vanes seemed to increase. The air speed indicator hand slid back until it was nearing twenty. I was trying a stall. Already I was far below the flying speed of the lightest plane. Subconsciously, I braced myself for the terrific downward plunge or the dizzying tail spin that follows a stall in an airplane. But nothing of the kind happened. We seemed floating in space.

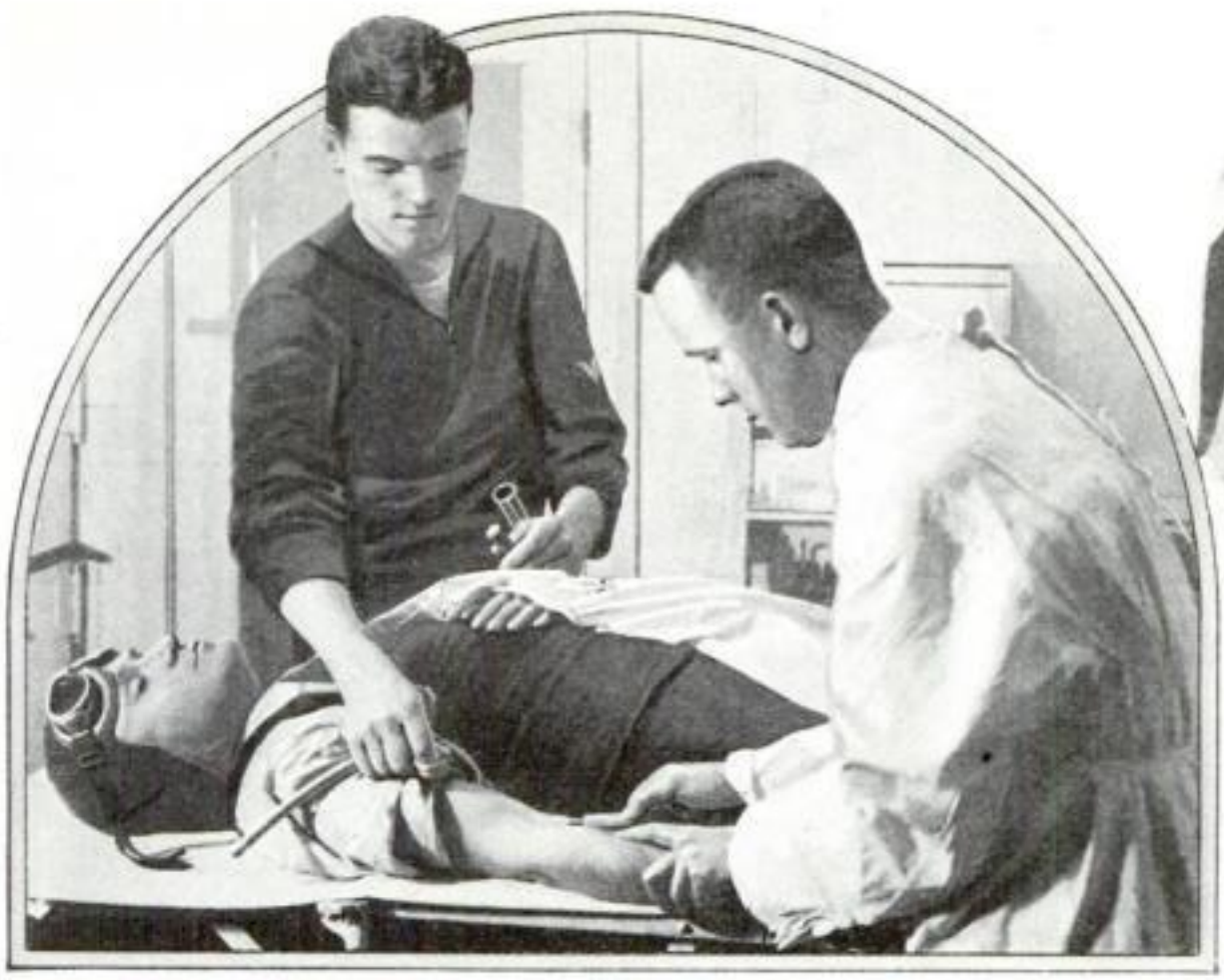
I looked over the side of the cockpit. We were directly above the high water tower at the edge of the field. The yellow letters circling its top: "PITCAIRN FIELD," were slowly rising toward me. I was settling straight down through the air. The ship was coming down out of the sky like an elevator.

The faster the autogiro settles, the faster the rotor spins, just as a windmill speeds up when the breeze freshens. No matter at what altitude the machine is stalled, it merely settles. In the "flying windmill," the deadly tail spin is unknown. The reason is that the wings continue to rotate at hundreds of miles an hour and so maintain flying speed even though all forward movement of the craft has stopped.

It was a tail spin that led Juan de la Cierva, the Spanish designer, to invent the autogiro. *(Continued on page 146)*

In circle, Jordanoff examines the manner in which the vanes are attached to the plane. Above, Ray, right, explains to Jordanoff exactly what the vanes are designed to do.

At left, Jordanoff and Ray inspect the landing gear. In his first landing Jordanoff expected a rough jolt when he hit the ground but he struck with only a slight jar.



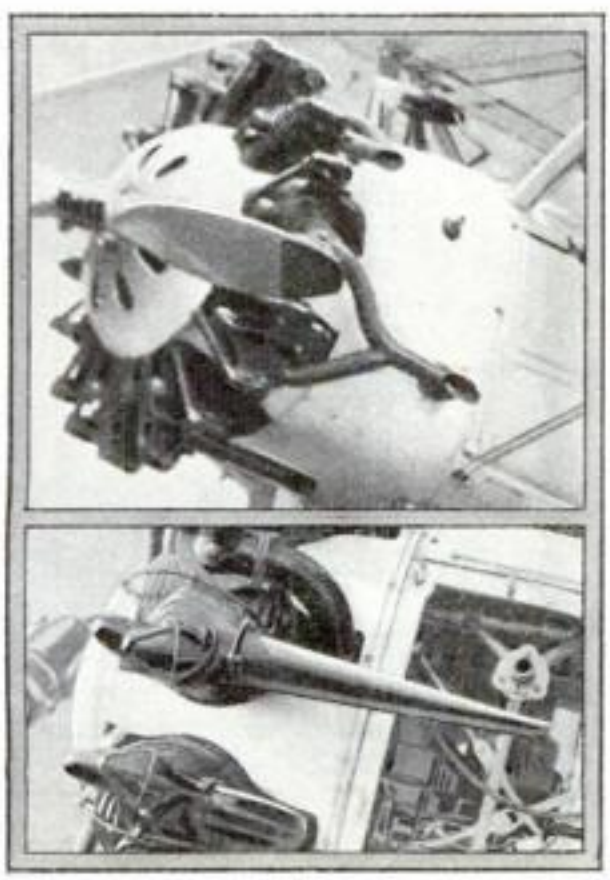
Lieutenant Commander Joel J. White, Navy Flight Surgeon, is taking a blood sample from an aviator following a flight. It will be tested for possible traces of monoxide.

With this suction pump device, Navy surgeon obtains sample of cockpit air to be tested.

Navy Rids Airplanes of Deadly Gas

By JAMES NEVIN MILLER

CLOSELY following announcement of Dr. Miller Reese Hutchison's invention of a "monoxide meter," which was described in the February POPULAR SCIENCE MONTHLY, U. S. Navy officials disclosed the details of the most extensive study ever conducted for the purpose of eliminating the carbon monoxide menace from flying.



At top, the Navy's new manifold type of exhaust outlet and below it the bayonet type.

The device of Dr. Hutchison, formerly chief engineer for Thomas A. Edison, warns automobile drivers and airplane pilots when their engines exhaust fumes of the deadly gas.

Government tests, which have just been completed under the direction of Lieut. Commander Joel J. White, Navy Flight Surgeon, disclose that the danger of monoxide poisoning appears to be present only in two types of open-cockpit planes. All of the cabin ships tested proved free from the menace.

The reason, the experiments showed, is that the monoxide fumes usually enter a plane on air currents that carry them back from the exhaust of the engine, following the general contours of the fuselage. Naturally, the entrance of gas in this manner is next to impossible in a cabin plane.

The investigators concluded that the remedy lay in changing the direction of the exhaust leads in the two planes. They found ways to switch the air currents to one side, so they would not be swept along the line of the fuselage into the cockpit, without interfering with the ship's proper streamline or materially reducing motor efficiency and speed. The tests then were repeated, and not a trace of the gas was found.

Blood samples are compared with standard specimens to see if gas is present.

THREE kinds of exhaust lead systems were tried out. The first is known as the "bayonet stack," consisting of a series of individual exhaust stacks shaped like bayonets, each of which is attached to a separate cylinder of the engine. This type of lead is about a foot long, two and one half inches in diameter at the point where it joins to the cylinder, and tapers gradually to less than half an inch at the rear end.

The second also was an individual type of exhaust lead, but an ordinary round pipe was used instead of the bayonet stack. The third system involved what is known as manifolding the exhaust outlet, meaning that the outlet systems of several cylinders are grouped so that a single exhaust outlet is provided for each group.

Twenty-five research experts and pilots participated in the experiments, conducted over a period of two months at the Naval Air Station at Anacostia, D. C. The research program centered around two types of test. First, blood samples taken of a pilot and other occupants of a plane were examined in the laboratory for possible evidences of the deadly gas. Secondly, air samples taken by means of a special device from the cockpit or cabin of each plane tested were examined in the laboratory.

The blood tests were made in this manner: To the blood in the test tube were added water and pyrogallic and tannic acid, a mixture which gives normal blood a light gray color. If carbon monoxide is present, the color will turn pinkish when the acids are added, the exact shade depending on the amount of poison present.

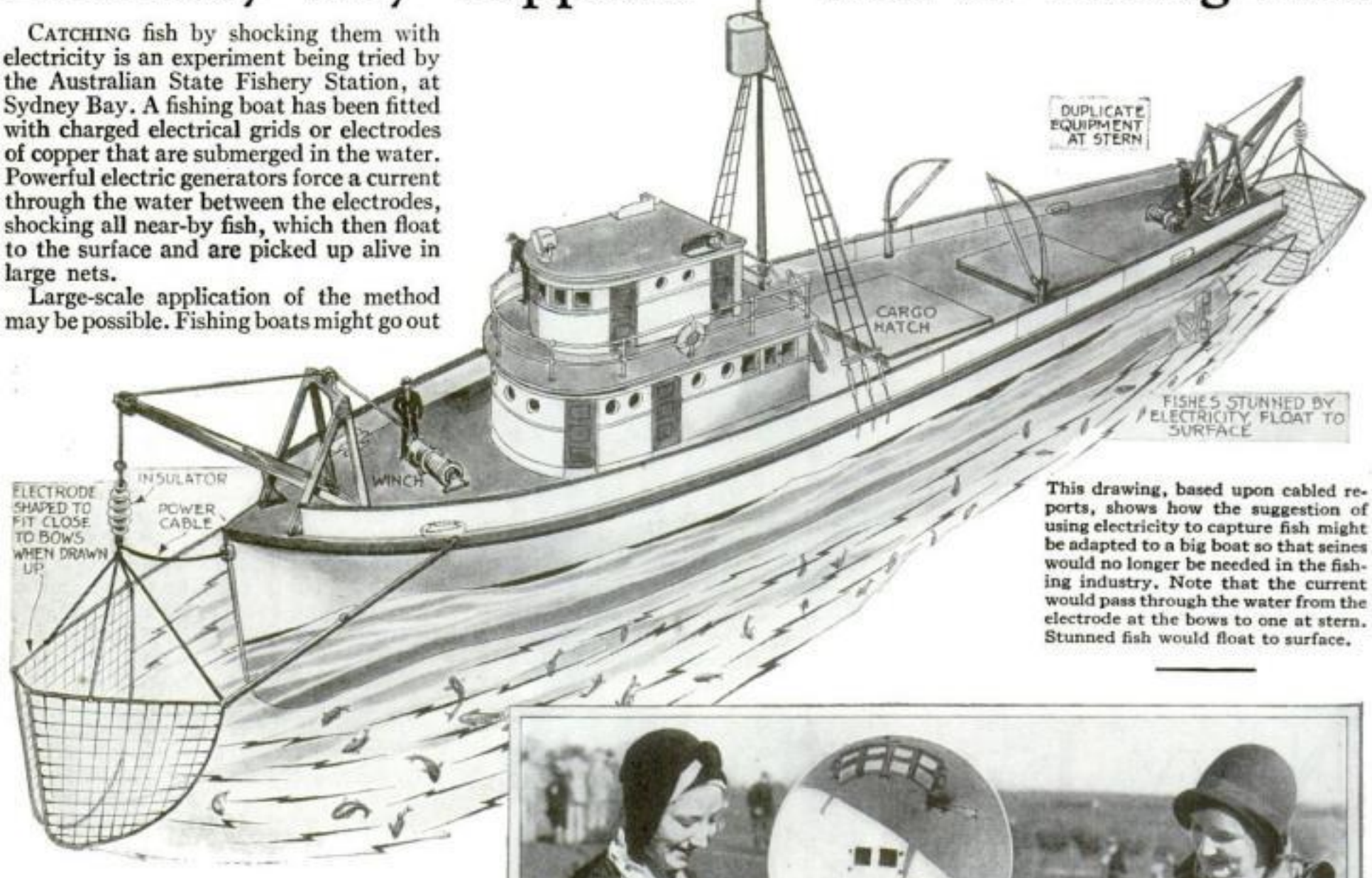
(Continued on page 148)

Electricity May Supplant Nets in Taking Fish

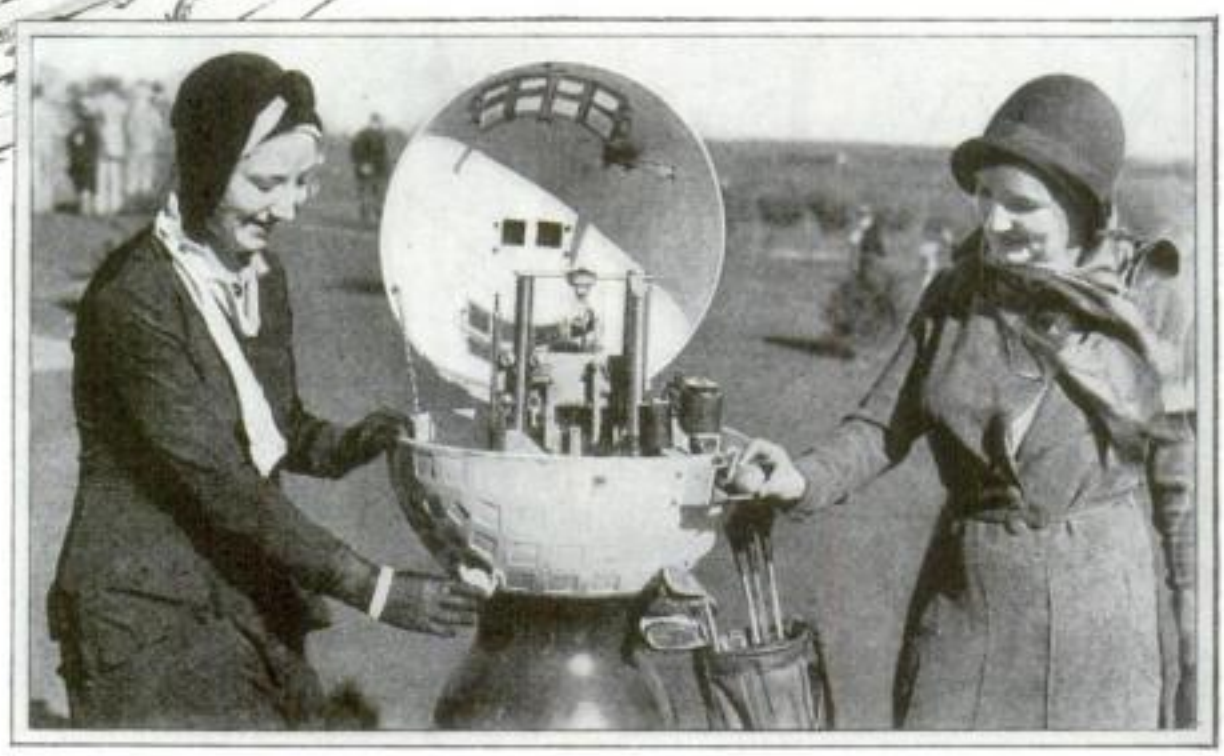
CATCHING fish by shocking them with electricity is an experiment being tried by the Australian State Fishery Station, at Sydney Bay. A fishing boat has been fitted with charged electrical grids or electrodes of copper that are submerged in the water. Powerful electric generators force a current through the water between the electrodes, shocking all near-by fish, which then float to the surface and are picked up alive in large nets.

Large-scale application of the method may be possible. Fishing boats might go out singly or in pairs, to fish electrically. Single boats would have electrodes at bow and stern. If two boats operate together, each would use a single electrode and an electric cable would connect them.

A Swedish engineer named Möller devised this electric fishing, after making good hauls with an electrified rowboat. The drawing on this page, based on cabled reports of his system, shows how it might be applied on a large wooden-hulled fishing ship. A metal hull could not be used, as it would short-circuit the current.



This drawing, based upon cabled reports, shows how the suggestion of using electricity to capture fish might be adapted to a big boat so that seines would no longer be needed in the fishing industry. Note that the current would pass through the water from the electrode at the bows to one at stern. Stunned fish would float to surface.



COSMIC RAYS MAY FORECAST WEATHER

Dr. R. A. Millikan at work with his latest electroscope, with which he is studying the cosmic rays. He believes these mysterious rays may be used in making reliable forecasts of the weather.

COSMIC rays may help to prophesy the weather. This first practical use for the mysterious radiations from outer space was recently announced by Dr. R. A. Millikan, Calif. Institute of Technology physicist.

The "cosmic rays" are more penetrating than radium or X-rays, but it is not known whether they affect human beings.

Dr. Millikan, who discovered the source of the rays (P. S. M., July, '28, p. 13), has measured their strength with his new electroscope, and is able to determine high-altitude atmospheric conditions.

AUTOMAT CLEANS AND PAINTS GOLF BALLS

DROP a coin in the slot and this machine will automatically clean and paint your golf balls. Electric mechanism dips the ball in a mixture of lacquer, then holds it in a strong current of warm air and when dry delivers it to the player ready for use. One of the machines is now in use on a Los Angeles, Calif., golf course.

The device is appropriately shaped like a huge golf ball on a tee.

RECORDS FIRE CALL

PROBABLY the most excited conversations preserved on wax records are those kept by the Portland, Ore., fire department. When an agitated voice announces over the telephone, "My house is on fire!" a dictating machine is plugged in to record the conversation. If he mumbles the address and hangs up before the operator can ask him to repeat it, it is necessary only to play back the record.

PRIVATE RAILWAYS CLIMB STEEP HILLS

HIGH up on the sunny hilltops of California are many homes, but climbing to some of them is hard work. William Schoenfeld, motion picture engineering expert, didn't like the climb to his home near Beverly Hills, so he built a small electric cable railway to carry passengers and supplies up or down. An electric motor furnishes power for this little private road that is operated by push buttons at top and bottom of the incline.

Charles V. Maris, of Los Angeles, had no objection to the climb to his home from the road, but he didn't like carrying supplies up it. He also built an inclined railway, but one for freight only. Power is supplied by a one-third-horsepower motor that hauls one-hundred-pound loads from the road to the top in forty-five seconds. The picture at the right shows the steep incline up which the electric car runs to reach the Schoenfeld home. Below it is a close-up view of Maris' car.

Charles V. Maris, Los Angeles, at the cable of the motor-driven railway that climbs hill to his home.

NEW MUSICAL CHIME REPLACES DOORBELL

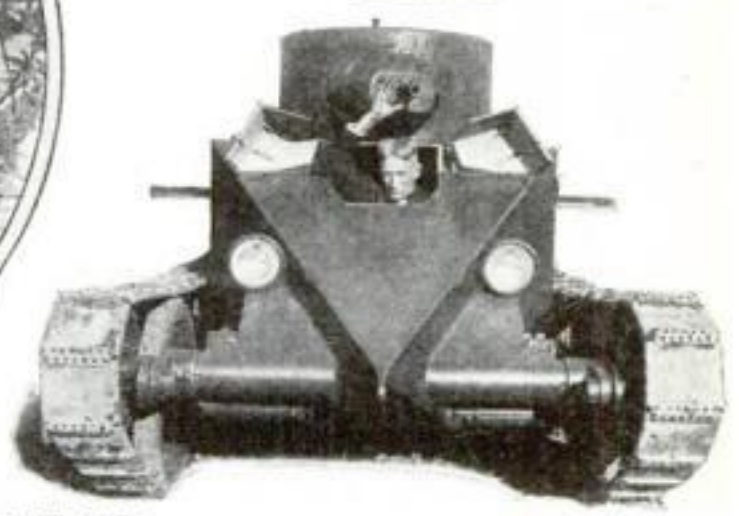
A SINGLE musical peal of a chime announces a caller is outside the door of your home, when a new electric "door chime" is substituted for the conventional doorbell. Easily installed even by an inexperienced person, it works either on batteries or a transformer.

This musical chime can be installed in home to sound when a button is pressed.

Only one note is sounded when the doorbell button is pressed, even if it is held down by an impatient visitor. A removable resonator tube magnifies the tone so that it may be heard throughout the house.

RADIO FINDS BURIED COIN

SCIENTISTS digging up remains of Roman civilization in England have been aided by a radio device that detects buried metals. When it is carried over the ground, buried metal objects cause a disturbance registered on an electric meter. This instrument is said to detect the presence of a single coin.



ARMY SEES HUNDRED-MILE-AN-HOUR TANK

THE fastest tank in the world whizzed along a three-mile stretch of macadam highway at Linden, N. J., a few days ago, and Army observers clocked it at 104 miles an hour.

J. Walter Christie, New Brunswick mechanical engineer and inventor of the tank, put it through its paces for Army officials. When he had finished, they announced they would recommend that the Army adopt it.

Opening wide its 338-horsepower Liberty airplane motor, Christie drove his tank at a speed of forty-five miles an hour across a field strewn with logs and rocks and through a brick wall. It climbed a forty-five-degree incline at thirty-five miles an hour.

A one-pound cannon, a machine gun, and five-eighths-inch armor plate are its weapons of offense and defense. The Japanese government has purchased the right to manufacture 100 of the tanks.

Two pictures of the world's fastest Army tank. It recently went 104 miles an hour and crossed a rough field at 45-mile clip.

NEW ORLEANS' FLOOD VALVE FINISHED

In oval a closeup of the Carré Spillway and below an air view of it with concrete backing.

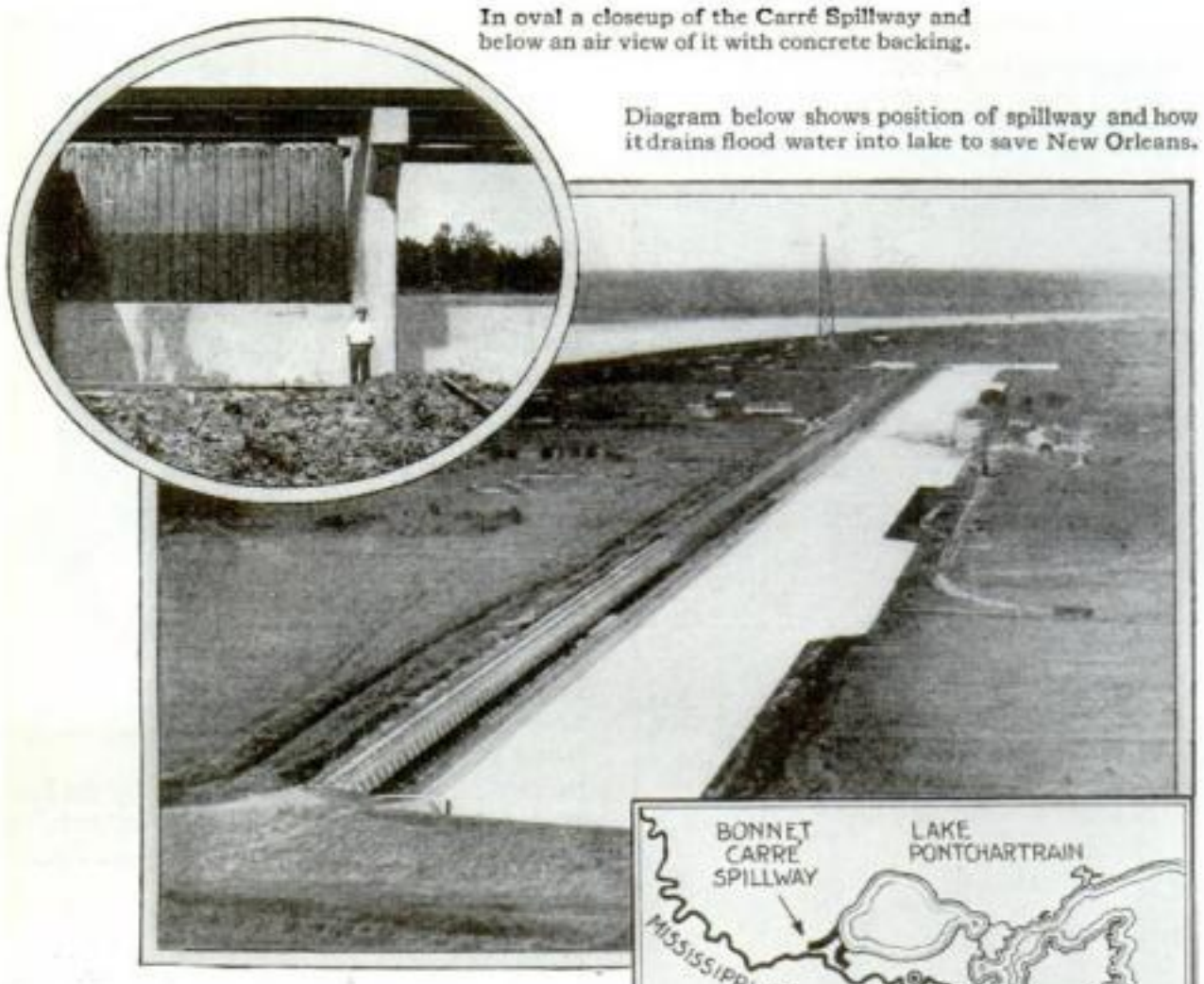


Diagram below shows position of spillway and how it drains flood water into lake to save New Orleans.

TWENTY-EIGHT miles above New Orleans, engineers have virtually completed a $3,000,000 safety valve and when the Mississippi is on a rampage, the Bonnet Carré Spillway will be ready for it.

During the flood of 1927, it was necessary to dynamite the levees and flood surrounding country below New Orleans in order to save it. The Bonnet Carré Spillway will divert the waters into Lake Pontchartrain.

When waters reach the six-foot level on the dam at the river's entrance to the spillway a traveling crane will race along the top pulling out wooden "needles," or twelve-by-twelve timbers that make up the face of the dam. This will let surplus water into the spillway and lower the river level. The newly-completed project is a vital part of the threefold Mississippi flood control program now under way.

TARANTULA'S BITE FAILS TO KILL

PROFESSOR P. W. FATTIG, curator of the Emory University Museum in Atlanta, Georgia, made a large tarantula from Honduras bite him the other day. The professor said he tried the experiment partly out of curiosity and partly to prove his contention that bites of such insects are not necessarily fatal.

It took about half an hour's poking to make the supposedly vicious creature bite. Then it hung onto the professor's thumb with a bulldog grip for about three minutes before it was pried off. Professor Fattig said the bite was two or three times as painful as a bee's sting and his thumb felt about three times its normal size. There were no other ill effects and the swelling soon disappeared.

THEATER CHAIR HAS ADJUSTABLE BACK

A NEW theater seat with pivoted back, recently developed in Seattle, Wash., may prove a convenience to theater-goers. When a belated arrival tries to squeeze into a row of seats, the occupants do not have to rise to let him by. Remaining seated, they push against the back rests of their seats, moving them to a vertical position and increasing the space between their knees and the backs of the seats in front. The new seats take up no more room than those now in use, to which the pivoted back can be attached.

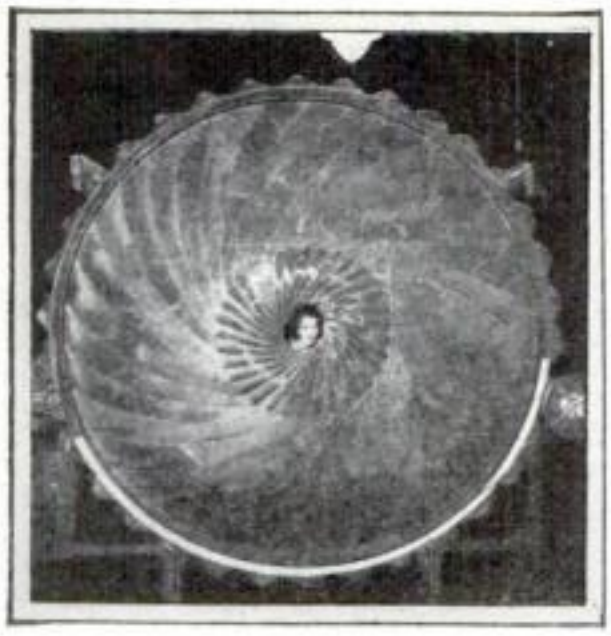
Pushing back in these new theater chairs, pulls the knees out of the way so others can pass easily.

MATCH LIGHTS 600 TIMES

A NEW match, devised by a Vienna chemist, can be used at least 600 times before becoming useless. It resembles a woman's lipstick, and is scratched upon its own case. It will not ignite if dropped or trodden upon, and it is practically unbreakable. The composition of the "everlasting match" is secret.

MOTORISTS WARNED TO LOOK OUT FOR PLANES

PLANES swooping in for a landing at the Grand Central Airport in Glendale, California, must cross a motor road at such low altitude as to menace cars. In order to prevent collisions between planes and cars, authorities at the field have erected a highway sign at this point, warning motorists of the danger. The sign resembles those used to warn motorists of their approach to railway grade crossings. This is believed to be the only point in the United States where aerial and highway traffic conflict.



GIANT "IRIS" COVERS LIGHT MEASURER

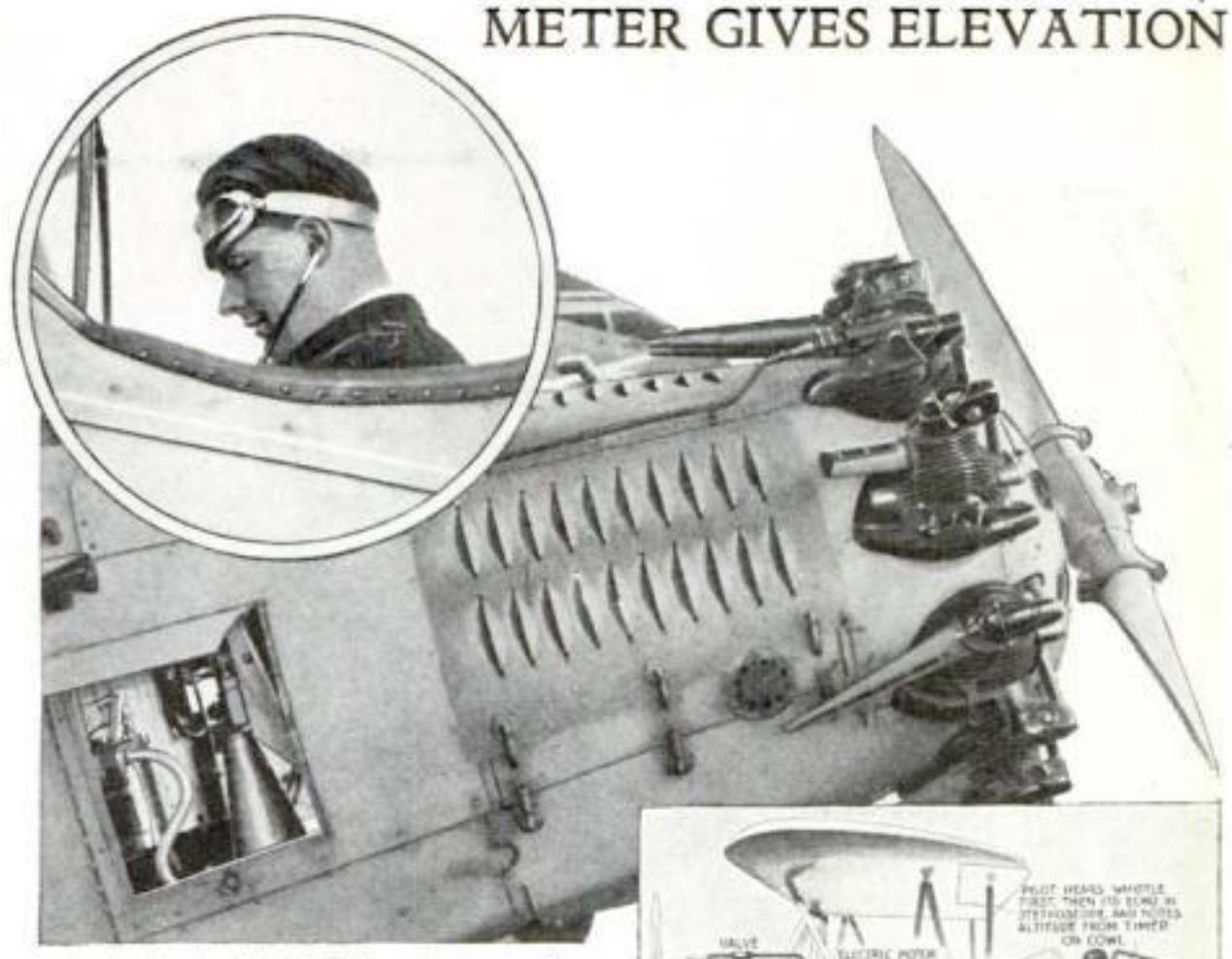
A STRANGE "iris" blooms in the laboratory of an electric company. In design it is strikingly similar to the iris diaphragms with which the lenses of pocket cameras are equipped. It measures nine feet in diameter. Its monster size is evident from the young woman's face in the photograph. The huge "iris" covers a photometer, or "light-meter", that can measure the light output of a billion candlepower searchlight or the tail light of an automobile. A hand wheel adjusts the size of the aperture at the center to let more or less light through. The photometer has been especially valuable in the effort to develop super-searchlights, as with it their power is determined.

CIGARETTE IS LIGHTED BY SCRATCHING END

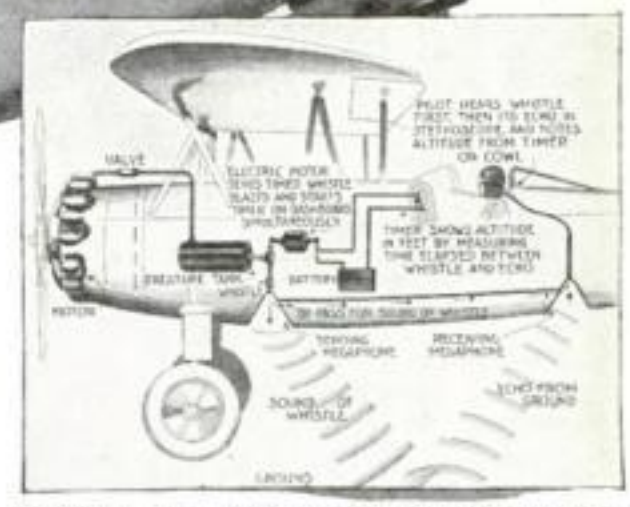
CIGARETTES that light themselves without matches have been made before, but this novelty in a new form has just been introduced by a San Francisco manufacturer. Ten cigarettes are packed in a box, each provided with a tip of yellow composition. Scratched like a safety match, upon a special surface of the box, a flare results that lights the cigarette.

A strong wind does not interfere with the lighting, according to the maker. He claims his composition is free of objectionable taste in burning, overcoming the principal problem of other inventors who have sought self-lighting cigarettes.

METER GIVES ELEVATION



In circle, Lieut. Albert E. Hegenberger, ready to test elevation meter in making blind flight.



In center, the altimeter as it is installed in a plane and diagram showing how the gage operates.

BORROWING an idea from the bats, the United States Army Air Corps and the General Electric Company have developed a "sonic altimeter" that tells a fog-bound pilot his height above ground, enabling him to land safely.

It is generally believed that bats in flight emit a high-pitched sound which, echoed back from surrounding objects, enables the animal to sense the nearness of obstacles during his night flights. Taking this idea, the engineers devised a whistle, blown at regular intervals of a second or two by power from the engine of the plane, and a means for catching its echo as it returned from the ground. The time required for this, which measures the altitude directly in feet, is registered on an indicator located on the plane's cowling before the pilot. The device was demonstrated recently at Bolling Field, Washington, D. C., by Lieutenant Albert E. Hegenberger, Army Air Corps, who was able to land a plane with its aid while "flying blind."

BIG GATE LIFTER CAN RAISE 500 TONS

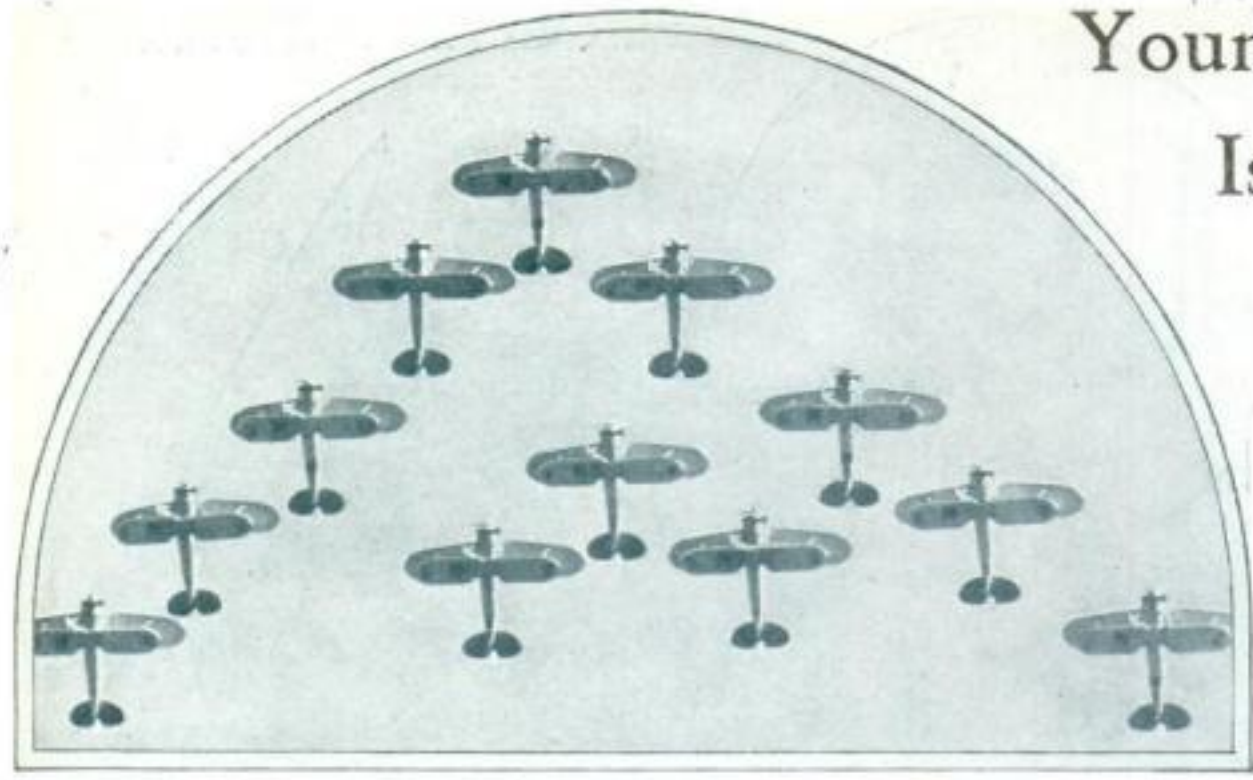
The world's most powerful lifting machine, built for use in case of emergency at Welland Ship Canal, will raise 500 tons ninety feet.

SAID to be the most powerful lifting contrivance ever built on land or sea, a huge floating misshapen boat is now nearing completion at the Welland Canal dry docks, Port Weller, Ontario. The 106-foot steel crane it carries is capable of raising 500 tons nearly ninety feet. It cost nearly a million dollars to build but it may never be used.

Specially constructed to pick up the 450-ton lock gates of the new Welland Ship Canal described last month (P.S.M., Feb., '30, p. 62), the strange craft has been christened a "gate lifter" by its builders. It will be used only in cases of emergency, because the lock gates may never have to be removed before they wear out.

The "gate lifter" must be towed since the engines in its squat hull leave no room for propelling machinery. Eight cables, each as big as a small tree, can be hooked to a damaged gate, when it is desired to lift it.

Youngest Air Squadron Is Navy's Safest



"Striking Eagles," the Navy's crack squadron of the air, won the Herbert Schiff Memorial Trophy as the safest unit in the service. Here they fly in V formation.

"STRIKING EAGLES," as fighting squadron VF-3B of the United States Navy is known in naval circles, recently received the Herbert Schiff Memorial Trophy for being the Navy's safest fighting unit. Last year they flew 4,958 hours, representing a distance of almost 600,000 miles, without an accident. The operations of the crack squadron included 861 day and night landings and take-offs from aircraft carriers.

During fleet maneuvers they flew in close and open formations over the Atlantic and Pacific Oceans and the Caribbean Sea. They repeatedly landed at full squadron strength, eighteen planes, on the decks of carriers at the rate of a plane a minute. Lieutenant Commander Samuel P. Ginder, in command of the squadron during most of the competitive year, received the trophy on behalf of its men.

This prize is offered annually to the safest and most reliable Navy air squadron by the family of the late Lieutenant Herbert Schiff, a naval reserve aviator killed in the line of duty in 1924. Squadron VF-3B, youngest in the Navy, was organized in 1927.

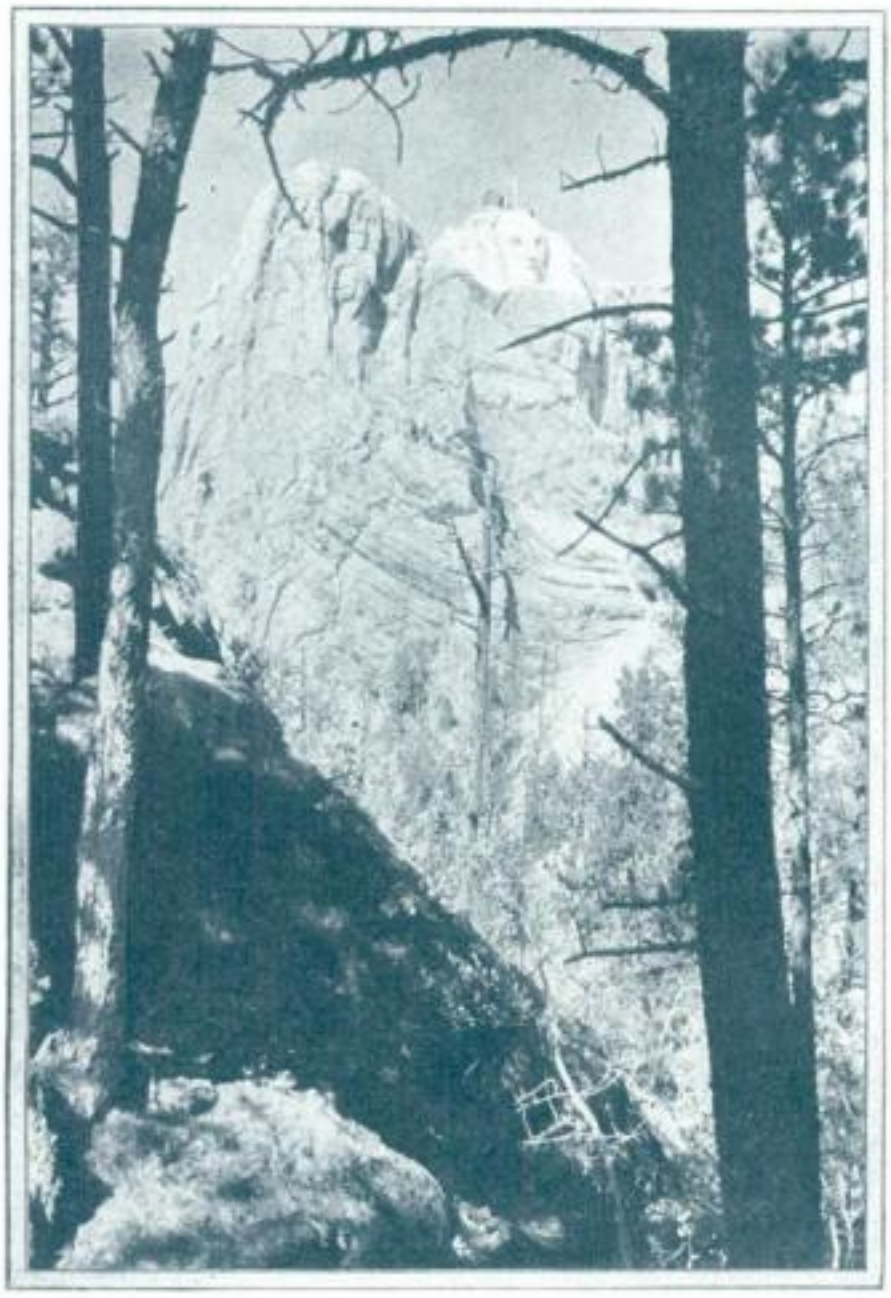
Their planes in perfect alignment, the unit flies over San Diego, Calif.

President Hoover presented the Schiff memorial to fighting plane squadron VF-3B, the trophy being received on behalf of the unit by Lieutenant Commander Samuel P. Ginder, left, the unit's leader.

At left, the members of the Navy's youngest squadron, which last year set a record for efficiency and safety. They were in the air 4,958 hours and flew a total of 600,000 miles, winging their planes above the waters of two oceans and the Caribbean Sea. They made 861 landings and take-offs from ships. With all this flying there was no serious accident.

Carving a Mountain Top into a Mighty Statue

NATIONAL MEMORIAL IN GRANITE. Out in the Black Hills of South Dakota, Gutzon Borglum, above, famous American sculptor, is carving out a lasting memorial on the top of the mountains. Here he is seen at work on a model of the group which, when finished next year, will consist of Washington, Jefferson, Lincoln, and Roosevelt.



GIANTS IN THE DISTANCE. In the background, at the top of the peak at the right, can be seen the head of Washington, around which the other heads will cluster. Cut upon the loftiest elevation of solid granite between the Atlantic and the Rockies, it is estimated that the memorial will endure 500,000 years. At the right of the heads will appear, in carved letters three feet high, a 500-word history of the United States.

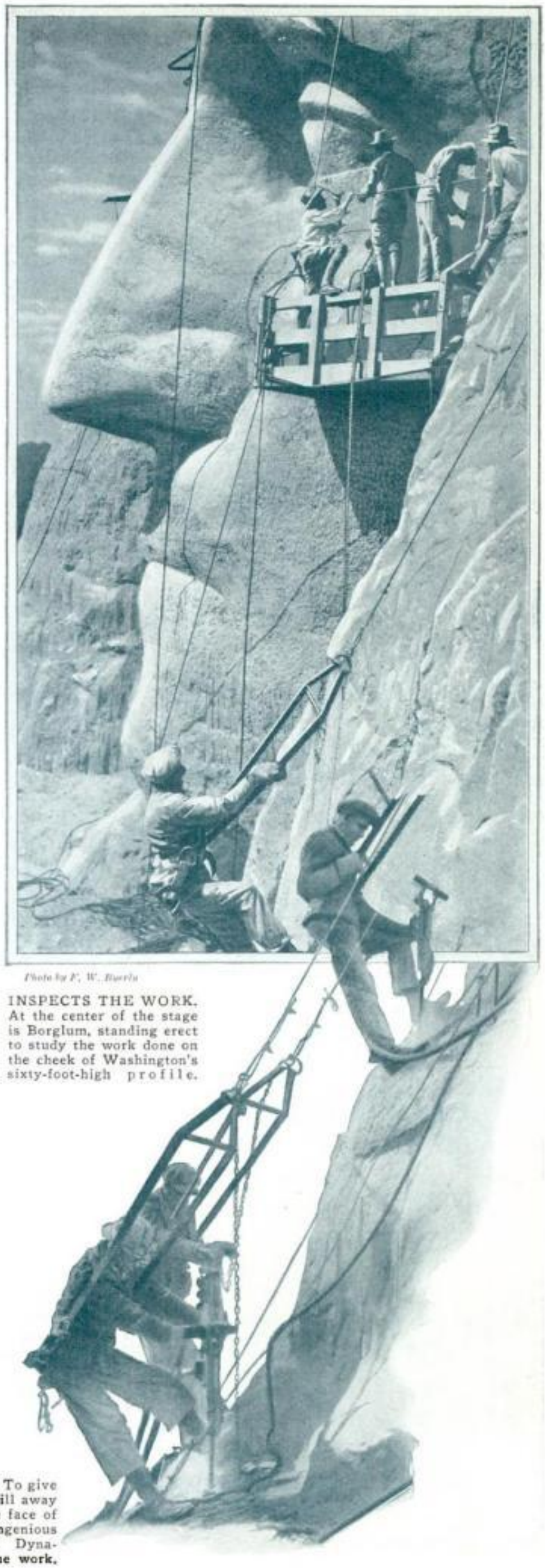


Photo by P. W. Harris

INSPECTS THE WORK. At the center of the stage is Borglum, standing erect to study the work done on the cheek of Washington's sixty-foot-high profile.

SADDLED TO CLIFF. To give workmen a chance to drill away the solid granite on the face of a 300-foot cliff, these ingenious saddles were designed. Dynamite has speeded up the work.

FOSSIL TREE LINKS AMERICA TO ASIA

Dr. H. E. Collins, of the Smithsonian Institution, holding the bit of fossilized redwood that is believed to prove the existence, at one time, of a vast bridge of land that joined the shores of North America and Asia.

A BIT of white volcanic rock hardly larger than a silver dollar has just come out of the Arctic to clinch the proof of a great land bridge, which, scientists have long believed, once linked the shores of Asia and North America.

On a tiny dot of land called St. Lawrence Island, in the center of Bering Sea, Dr. H. E. Collins, of the Smithsonian Institution, found this little piece of ancient rock. Embedded in its surface is a small, feathery leaf of *Sequoia langsdorfii*, a fossil redwood tree, almost identical with the *Sequoia sempervirens*, or giant redwood, still abundant in the Coast Range mountains of California. Its discovery in the center of the Bering Sea, plus the fact that it had already been found on each side, shows beyond question, Dr. Collins declares, that the island was once part of a land bridge connecting Siberia with Alaska.

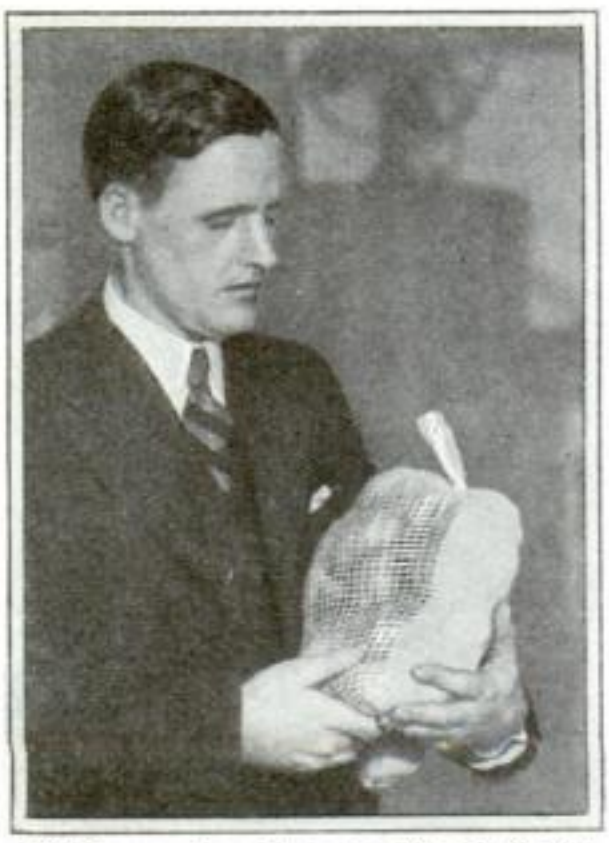
REGULATION JACKKNIFE IS KNIFE AND FORK

A JACKKNIFE that can be converted into a knife and fork is the product of a New York firm. When taken apart the two sides of its handle form separate handles for the knife and fork. Campers and picnickers, it is said, find this tool a convenience on their outings, since it reduces the number of implements they have to carry. The ingenious feature of this little device lies in the ease with which the two sides of the knife handle may be removed and rigidly snapped to fork and knife to form satisfactory and convenient handles, which in turn can be snapped back to give a regulation pocketknife.

BAG FOR VEGETABLES HAS SHOW WINDOW

A SMALL cotton bag with a show window in the rear has been perfected by textile specialists of the U. S. Department of Agriculture. The new bag is intended for use as a container in which stores may sell potatoes, onions, and similar products. The show window feature permits housewives to peer in at the back of the bag and see the size, shape, and condition of the contents without untying the bag's fastenings.

A special weave was necessary to produce a bag that was woven close enough on the front side to allow the printing of the name of the grower and the contents of the package, while retaining the lattice effect in the back of the bag. The bag was designed by R. J. Cheatham, who is in charge of research on new uses for cotton in the Department of Agriculture, at Washington, D. C.



Widely spaced mesh on one side of this bag permits a view of the condition of contents.

Dr. Charles Packard, Columbia University biologist, arranges his animals for test with big X-Ray tube seen at right.

GIGANTIC X-RAY TUBE WORKS FOR MAN

THE great X-ray tube that California Institute of Technology engineers recently completed, after three years of labor, has at last been put to work for humanity.

Dr. Charles Packard, Columbia University biologist, is using its potent rays in his search for new treatments for diseased human tissues. The subjects of his experiments are fruit flies, caged in glass bottles, and white rats in wire cages.

Ten million dollars' worth of radium could provide him with rays of no more power than this mighty tube. Because of the extremely high potential at which it operates—more than 6,000,000 volts of electricity—it produces rays resembling those of radium. Described in this magazine (P. S. M., Dec. '30, p. 35), its rays will penetrate more than two feet of concrete, and a barricade of sandbags helps to protect its operators.

DO YOU SPELL WELL?

IF YOU make mistakes in spelling, take comfort from the words of Clyde R. Miller, director of educational service of Teachers' College, Columbia University. The brightest students, he finds, are sometimes the poorest spellers. When he gave a series of tests in a Brooklyn, N. Y., public school, he found that the cleverest pupils frequently spelled a word according to its sound, rather than in accordance with the dictionary.

SNOW SHOVEL IS ALSO SMALL HAND PLOW

A VERSATILE snow remover recently was placed on the market by a firm in Chicago, Ill. It can be used as an ordinary snow shovel or, by means of an adjustment on its handle, as a small hand plow, for use where snow lies thick and loose.

In removing snow or slush from wooden steps or porch floors, the blade is reversed, and a rubber strip along the edge of the blade prevents marring or scratching the painted woodwork. This attachment also makes the versatile shovel a convenient tool for removing water from garage floors after they have been washed down, acting as a soft scraper, or pusher, that collects the surplus water.

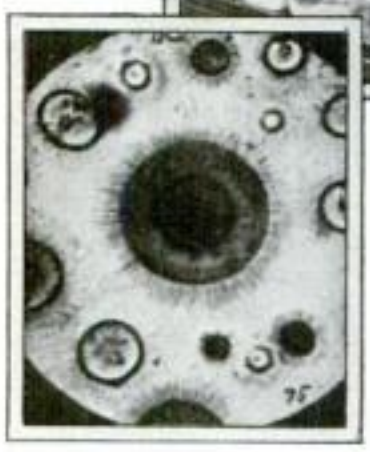
LABORATORY CELL BEHAVES AS IF ALIVE

WHILE searching for a way to check cancer, Dr. George W. Crile, noted Cleveland, Ohio, biologist, stumbled recently upon a phenomenon so close to the synthetic production of life—long a dream of laboratory workers—that the scientific world is still debating what its significance may be.

When Dr. Crile extracted supposedly lifeless fat and protein from the brain of a freshly slaughtered animal, and placed it in a solution to which certain salts had been added, strange microscopic objects appeared which he termed "autosynthetic cells." This name, he said, described their ability to put themselves together. Not only do they resemble living cells, but they multiply by splitting in two, just as live cells do.

Their reactions to oxygen, and to poisons, are nearly identical to those of the ameba and other simple living cells. They particularly resemble the cancer cell, which grows at the expense of other cells in the human body, and whose only function is growth.

"Somewhere in the vague ground between the lifeless and the living," is Dr. Crile's cautious description of them. "If news had not leaked out prematurely," he declares, "I would not have discussed this matter for months." Meanwhile Dr. Crile is continuing his experiments and a few months may give him data for a more conclusive statement.



C. E. McClung, University of Pennsylvania biologist, examines Dr. George W. Crile's autosynthetic cell which behaves as though alive.

At left, a microscopic enlargement of the strange cells that were made in Dr. Crile's laboratory and which he describes as being somewhere between the living and the dead.

GIRL INVENTS WAY TO PUT METAL ON CLOTH

INVENTOR in her own right is Natalie Hays Hammond, of New York City, who comes of a mechanical-minded family. Her father, John Hays Hammond, is a famous Washington, D. C., mining engineer, and her brother, John Hays Hammond, Jr., has patented more than 400 inventions in radio and other fields.

Miss Hammond at twenty-four has devised a secret process by which decorative metals can be applied to fabrics for women's dresses—and to other materials as well. Once applied, it is said, they cannot come off. Miss Hammond patented her process, and now has 1,500 workmen in her New York factory.

Miss Natalie Hays Hammond exhibits fabric coated with metal by a process she invented.

COTTON PICKER DOES WORK OF GANG

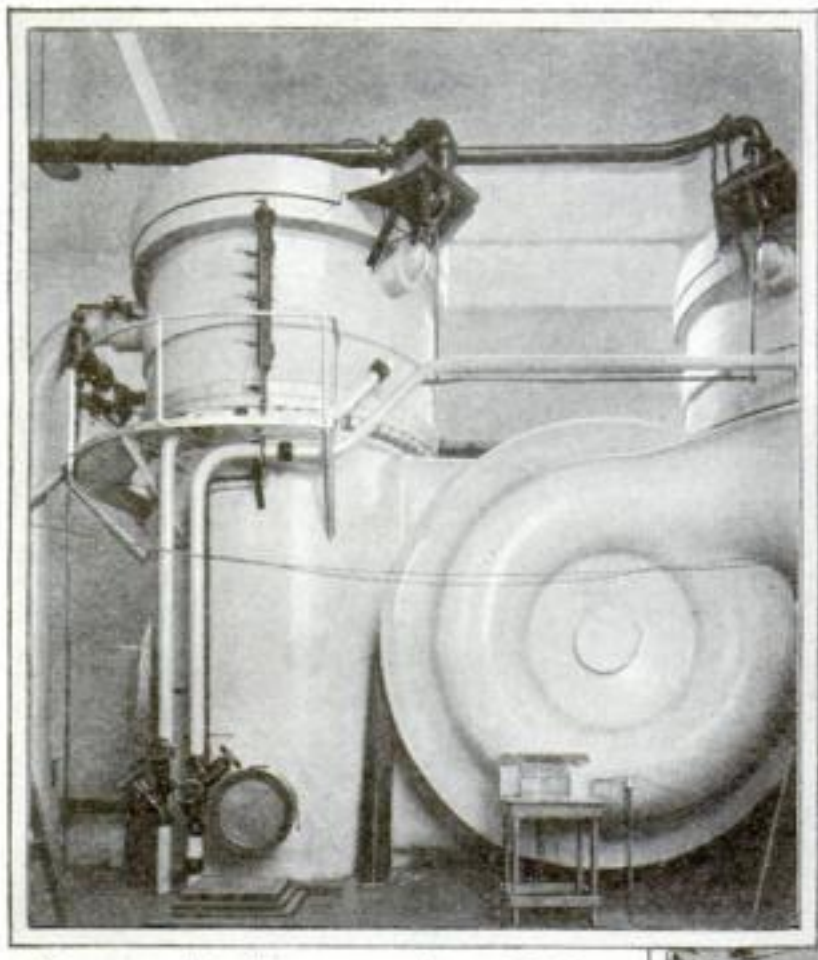
A STRANGE-LOOKING machine crawled up and down cotton fields at an experimental cotton farm near Stoneville, Miss., recently, doing the work of many laborers in harvesting the crop. Machinery has been tried for this work before, but it has never proved entirely successful. All the cotton bolls—or buds from which the fiber is picked—in one crop do not ripen at once, making it necessary for the pickers to make several trips over the fields before the crop is all gathered.

Machines tried for this work have damaged the plants and bolls so much on the first trip over the fields that their use has been abandoned. The new machine, a product of a Pittsburgh, Pa., firm of cotton machinery manufacturers, is said to have proved successful in gathering the bolls without injuring them.

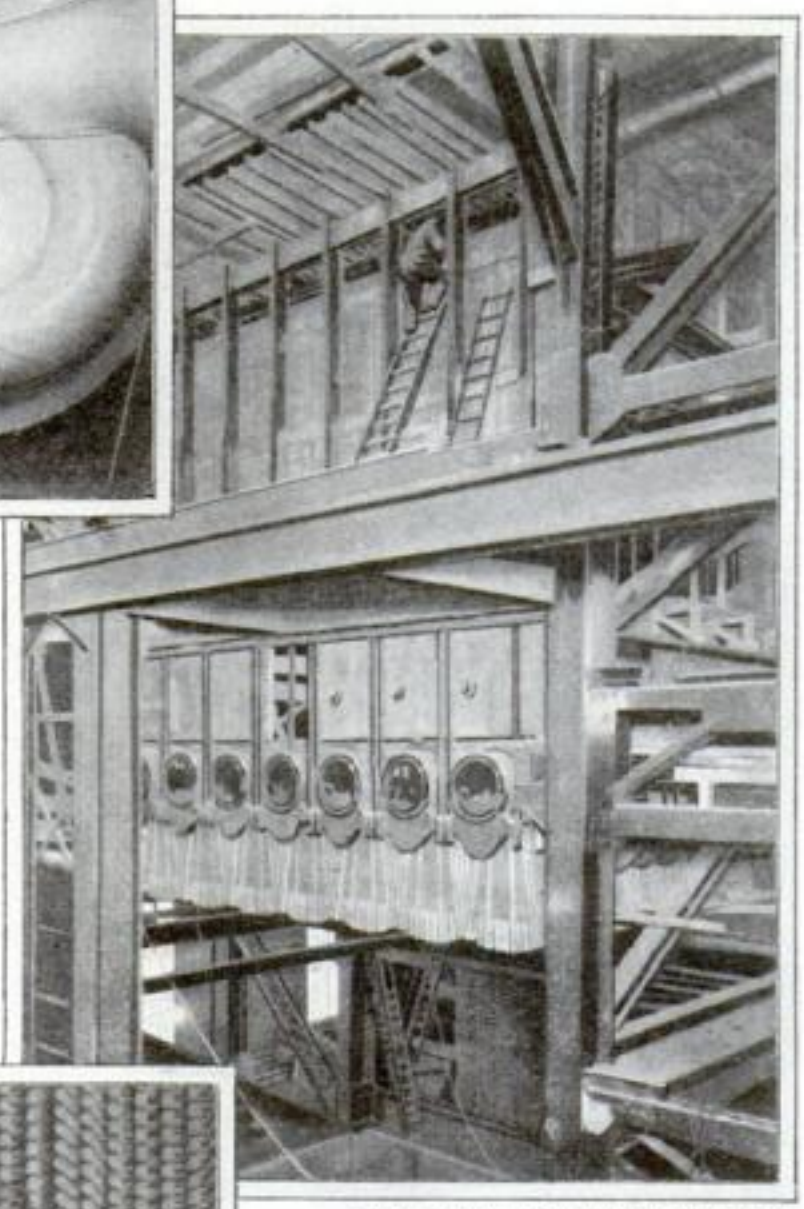
Mercury Turbine Now a Success

New Power Idea Proves Its Value in Practical Use As Quicksilver Vapor Spins Electric Generator

By EARL CHAPIN MAY



Mercury turbine between sections of highly efficient mercury condenser steam boiler.



Ninety tons of mercury circulate six times an hour in the boilers.

Looking up at the dead end tubes in which mercury vapor is generated.

WHEN, in 1914, William LeRoy Emmet, General Electric Company research engineer, first proposed that mercury vapor instead of steam could be used to drive a turbine wheel, scientists and engineers scoffed at him.

They said that while the physical characteristics of mercury, its boiling point, specific heat, and so on made the idea theoretically possible, insurmountable obstacles lay before anyone who tried to work it out in a practical way.

Pointing to the tiny leaks that often occur in steam piping, they said that similar leaks would certainly occur with mercury vapor, which is even harder to confine than steam. Such leaks, they claimed, would waste valuable mercury and kill all the engineers, because mercury vapor is exceedingly poisonous.

However, Emmet refused to listen and built an experimental machine. These early tests were described in POPULAR SCIENCE MONTHLY.

A few days ago, I saw in operation a mercury vapor power plant of full commercial size that, during the last year, has set a low figure for the use of coal such as the world has never before seen!

This startling result was made possible by the foresight of T. H. Soren, vice president of the Hartford Electric Company, of Hartford, Conn. He was so impressed with the results that were obtained from Emmet's first tests that a deal was made with the General Electric Company to continue the work on a larger scale. So in 1923 a 5,000-horsepower experimental mercury vapor unit was constructed and installed at the Hartford Electric Company's Dutch Point power generating station.

During the years that followed, test runs bore out Emmet's theories, but some of the troubles predicted by the scoffers also were encountered.

A boiler head blew out and thousands of dollars worth of the valuable mercury escaped. Only part of it was recovered. A turbine wheel went to pieces under the strain and caused a shutdown for several months. Workers were overcome by the fumes of the poisonous mercury. There were, however, no fatalities, nor was anyone permanently injured, because of the unusual precautions taken by the company to protect the men who had charge of the work.

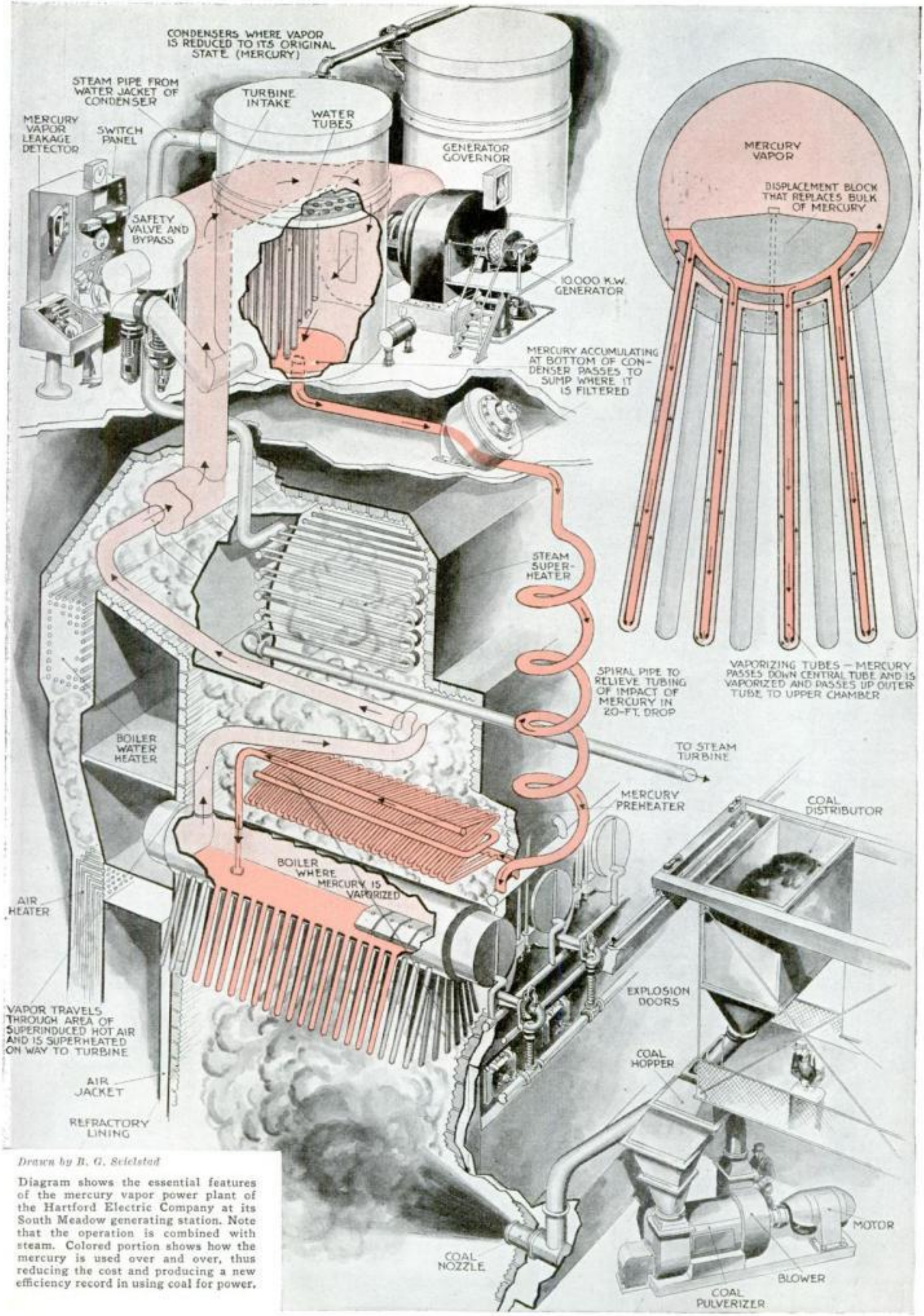
After Soren, James Orr, the company's superintendent of power, and their assistants had learned all they could from the first experimental plant, a second was built with such changes as experience dictated. This unit gave improved results but also developed some defects.

Then, utilizing the engineering knowledge gained from the years of experimenting with the first two units, the company decided to build a real, commercial size, mercury boiler unit at its South Meadow generating plant.

It was this plant I recently inspected. I had gone prepared to see only experimental apparatus that possibly produced results when it ran during the intervals between costly and dangerous breakdowns. I found instead a power house unit that was solidly engineered, permanently installed, and running without any sign of trouble. In fact it is now planned to follow the general design of this plant in building a unit twice as large, 20,000 kilowatts in capacity, in the new power plant of the Schenectady works of the General Electric Company.

THE South Meadow mercury boiler unit is producing as high as 143 kilowatt hours of electrical energy for each 100 pounds of coal burned. The finest steam power generating plant in operation today produces only 112 kilowatt hours of energy from that much coal. According to United States Government reports, the average efficiency of all the public utility power plants in the country is fifty-nine kilowatt hours from 100 pounds of coal.

(Continued on page 142)



Drawn by R. G. Seielsted

Diagram shows the essential features of the mercury vapor power plant of the Hartford Electric Company at its South Meadow generating station. Note that the operation is combined with steam. Colored portion shows how the mercury is used over and over, thus reducing the cost and producing a new efficiency record in using coal for power.

New Weapons Win in War on Forest Fires

By ROBERT E. MARTIN

CELEBRATING the twenty-fifth anniversary of its existence, the United States Forest Service last year set a record for speedy stopping of forest fires.

In spite of a nation-wide drought that turned the summer woods to tinder, and of the fact that there were more fires than the year before, the loss in the national forests was reduced *eighty* percent and the average area burned was cut from 131 acres in 1929 to less than twenty-five acres in 1930.

Forest fires were stopped in their tracks and few did extensive damage.

Behind these impressive figures lies a record of continual experiment to adopt the latest scientific discoveries to the work of the forest patrol. The fire fighters today form a mechanized army whose equipment would have amazed even the most optimistic prophet when the service began in 1905.

Airplane loudspeakers, warning campers out of the path of the fire and directing the fire-fighting from the sky; huge tractors, almost as big as war-time tanks, smashing their way through underbrush, plowing fire lines to cut off the advancing flames; small portable radio sets, giving the latest information to workers; large planes, landing in emergency fields cleared in the forests, bringing additional men and supplies. Such are the things now being experimented with by the service.

IN THE 149 national parks owned by the United States, there is a total area of 160,000,000 acres, an expanse greater than the whole state of California. A regular force of only 2,700 men must watch over this vast territory. By using the airplane for eyes and the radio for ears, they accomplish the seemingly impossible task.

Last summer a portable radio set rugged enough for the work was developed. This

Formerly forest fire fighters patrolled their districts on horseback, but now their work is speeded up with airplanes, autos, and trucks.

An airplane patrol signal, on Timber Mountain, Modoc National Forest, California. This enormous triangle marks an emergency landing field cleared for the flying firemen.

Portable radio set, designed by Forest Inspector D. L. Beatty, is strong enough to stand transportation into the region threatened by fires.

Left, lookout tower in Ocala National Forest, Florida; above, fire finder that determines the exact location of flames.

compact and sturdy instrument was designed by D. L. Beatty, a forest inspector in the Columbia National Forest, in Washington. Complete with batteries, antenna, and carrying case, the combined receiver and transmitter weighs only seventy-nine pounds. The batteries will give a season's service and allow twenty-five hours continuous use of the transmitter.

MESSAGES have been sent and received by the little sets over distances as great as 350 miles. Packed over rough mountain trails on mule back, or carried in by men, they have stood the jarring and pounding and have shown no ill effects, in spite of the fact that the vacuum tubes are not removed during transportation.

By the use of this equipment, forest rangers are collecting valuable data on the absorption of radio energy by green timber and on the "shadow" effect of mountains.

While some of the lookouts, watching for fires from high mountain peaks, are in touch with the head office only by wireless, the radio sets are not designed to supplant the telephone that connects most of the regular lookout towers with headquarters.

In 1905, there were less than 500 miles of telephone wires in the national parks. Today, in these parks, there are more than 35,000 miles of wire. The men in the observation towers have telephones at their elbows and at the first sign of fire notify headquarters.

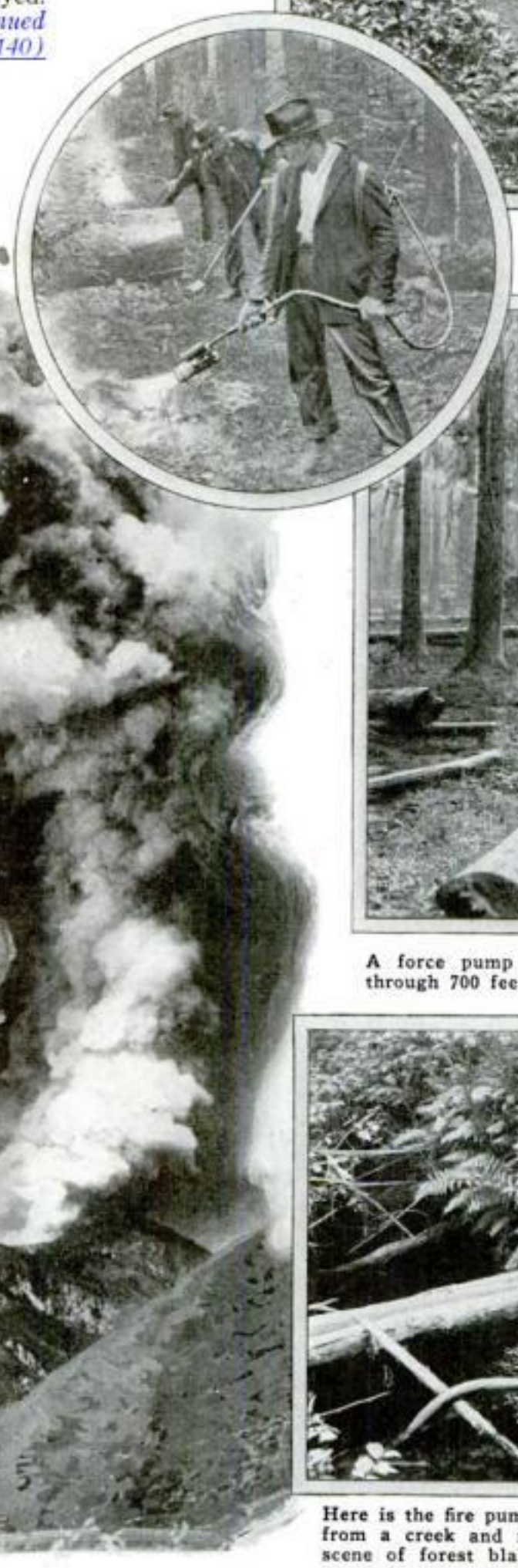
The value of such early reports is increased by the use of a simple device called the "fire finder." A pivoted bar, with two upright sights, is swung around until it is aimed directly at the smoke rising from a fire. The line made by the bar across the map on which it is mounted is noted by the observer and this information phoned in. Other lookouts make similar observations from different sides of the fire. The intersection of these lines on the headquarters map marks the exact location of the blaze. This knowledge saves valuable time in getting to the fire.

Every minute is precious when a fire begins eating its way into timber. In Colorado, a few years ago, one forest fire raced through 2,500 acres of valuable trees in three hours and a half. Where the fighters used to go on foot or on horse or mule, they now speed to the vicinity of the fire in automobiles over roads built at strategic points. From a total of about 300 miles of roads in 1905, the mileage of good roads in the national parks had jumped to nearly 17,000 by 1929.

Some of the motor cars are equipped with flanged wheels so that in an emergency they can race over railroad rails to the threatened area.

Gasoline engines have joined the fire fighters in another important way. Huge tractors are being used to break roadlike paths through the underbrush, to help the workers make fire lines, and gouge out gaps at which the flames are stopped or at least delayed.

In *(Continued on page 140)*



Digging a trench or fire trail and, at left, backfiring, the next step after trail is dug.

A force pump drives a stream of water through 700 feet of hose to stop forest fire.

Fire near Siuslaw National Forest in Oregon. Photo taken soon after it started. At right, a smoke cloud above Echo Mountain, California.

Here is the fire pump in action, drawing water from a creek and forcing it through hose to scene of forest blaze hundreds of feet away.

Ugly Green *Mold* Is *Food* and *Medicine*

You would turn up your nose in disgust if offered bread covered with green mold.

By MARSHALL ANDREWS

YOU would turn up your nose in disgust if somebody offered you a piece of moldy bread at dinner, yet a half hour later you might eat with relish a piece of cheese, a product of that selfsame mold!

Recently scientists have found out much about mold, the strange vegetable growth that can occur in thousands of different forms. They are beginning to discover how to make mold produce materials at little cost that once could be made only by involved and expensive chemical methods.

They have discovered that no form of mold is poisonous, however deadly it may look. They have found, indeed, that mold, properly controlled, can be made a vital factor in promoting human health and happiness.

Mold is so all-pervading that you cannot avoid eating it and even breathing it. When you walk up to a soda fountain and order a soft drink, chances are you will be served with a concoction containing citric acid, one of the most general products of mold.

When you tear off the tin foil on a piece of yeast, you are preparing to eat a solid cake of a vegetable growth that is blood brother to the horrible stuff that festoons stale bread.

If you are a lover of good cheese, your roquefort and camembert will introduce you to forms of mold every time you indulge yourself.

Medically, mold has proved an unexpected ally in the treatment of calcium deficiency in the blood, a condition akin to anemia. The thousands who watched the progress of King George V of England in his recent illness and rejoiced at its fortunate ending little know that his recovery was hastened by injections of calcium gluconate, made by

When cheese mold, the kind that coats camembert, is seen under a microscope it looks like this.

American chemists in Washington laboratories from a form of mold.

In the manufacture of certain fine textile products it is necessary to impregnate fibers with starch and other chemical agencies to preserve them while they are being woven or knitted into finished articles. Textile mills employ several types of mold to generate enzymes that digest these "sizing" materials, leaving the finished product fresh, new, and impervious to the harsh ministrations of laundering machinery.

The adaptation of mold to industrial,

Having scorned moldy bread you have no hesitancy in eating mold-coated cheese.

medical, and agricultural uses has come about more or less accidentally. Many of these discoveries have resulted from the efforts of scientists of the U. S. Department of Agriculture to halt ravages of mold upon plant life and foods, costing millions of dollars annually.

Only recently, two chemists of the Department of Agriculture, Horace T. Herrick and Orville E. May, working in Washington to produce tartaric acid from mold forms, found themselves in possession of valuable knowledge. They made 150 experiments with different types of mold life, only to meet with failure in 149 of them. The last produced gluconic acid, which aided the recovery of the King of England and which, before their discovery, was a rare and expensive drug. The importance of their discovery may be understood when it is known that the cost of this valuable salt, under their process of production from mold culture, has been reduced from $150 per pound to only fifty cents per pound.

The calcium gluconate, made from the gluconic acid thus produced from molds, according to the Department of Agriculture, is now regarded as the only calcium salt that can be injected between the muscles of patients suffering from a deficiency of calcium without causing abscesses. It can also be injected into the blood stream or given through the mouth. In the latter connection, the Department issues the reassuring information that calcium salts produced from mold are practically tasteless in contrast to other forms of the drug.

A peculiar thing about molds

Samples of the different types of mushrooms which are just mold.

is that experts, who have spent most of their working lives experimenting with them, cannot state how many forms of mold there are. Mold is a mysterious vegetable, too small to be seen by the naked eye, and appearing in so many forms and in so many places that it baffles even the trained investigator.

MOLD comes in every color of the rainbow and in numerous shades of these colors. The same green mold that spoils your bread if you keep it too long is that which makers of roquefort cheese employ in seasoning their product. In fact, mold cultures for the manufacture of roquefort cheese are grown in bread and transferred to the cheese when it is ready to be ripened.

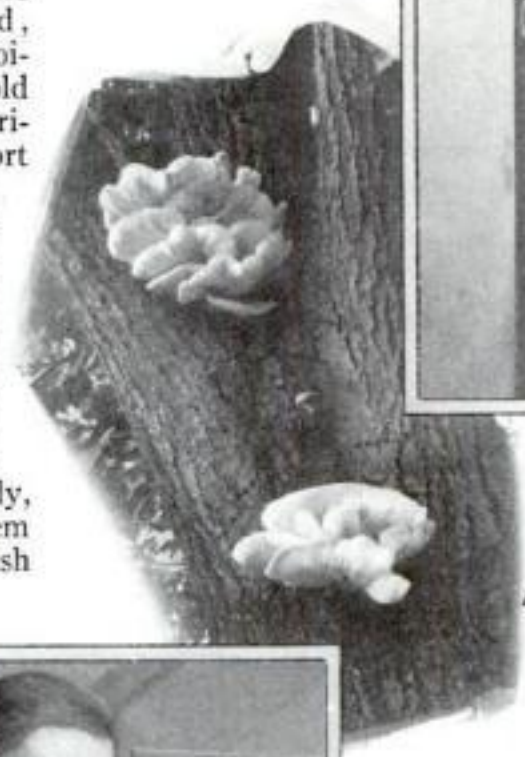
In this regard, mold is a true paradox. Manufacturers of food products spend thousands of dollars annually in an effort to stem its ravages on food shipments. On the other hand, the same manufacturers spend still more thousands of dollars each year nurturing mold to give them, quickly and cheaply, the results which only time can produce without the aid of mold.

Another peculiar fact is that mold, despite its unattractive appearance, is not poisonous. Dr. Charles Thom, of the Department of Agriculture, who has spent twenty-seven years studying mold, declares that no poisonous form of mold is known to experimenters. In support of this contention he cites an occasion upon which horses were fed oats in which mold had been permitted to form. Although the oats were thoroughly moldy, the horses ate them with apparent relish and suffered no bad effects whatever.

Some forms of mold are cannibalistic. In growing mold cultures, chemists usually employ such food bases as agar, starches, and other common nutritive agencies. A few molds, however, may be grown upon other forms, consuming their victims and growing fat and happy. These types are described as "predatory."

The care of food products in transit and in storage is a constant fight against mold. Until a few years ago, there was little information

Dr. May watches the growth of mold during the Bureau of Chemistry's efforts to produce gluconic acid.



At the left, another form of mold, an oyster fungus growing on a tree.

Dr. O. E. May, of Bureau of Chemistry, Department of Agriculture, tests mold growth.

available which would enable the shipper of foodstuffs to protect his valuable holdings until they had reached their market. Now, however, under advice of the Department of Agriculture, little loss is sustained by producers of food susceptible to attack by mold.

Protection comes in many forms. It was discovered, in one instance, that a new and peculiar form of mold was forming on eggs in transit, rendering them unfit for consumption and causing heavy losses to the producers. After careful study of this problem, it was learned that the eggs were being shipped in crates made of unseasoned wood. The use of fully seasoned crates solved the difficulty.

ON another occasion, during the World War, it was found that some 1,500,000 hams stored in Baltimore had either spoiled or become "musty." An investigation showed that in every instance the moldy hams had been "short cured," under permission of the Government, and that those which had been thoroughly cured withstood attacks of mold.

Scientists in the Department of Agri-

H. T. Herrick, of the Bureau of Chemistry, examines the mold grown in glucose solution.

culture who have studied mold for many years say that the average household refrigerator is no protection against formation of this parasite. Mold colonies, they say, will form readily enough in the temperature of fifty degrees Fahrenheit. In fact, one case is brought out in which beef, in overseas shipment, formed mold spots at twenty-two degrees Fahrenheit, or ten degrees below freezing.

REFRIGERATION, it seems, only delays formation of mold. Yet mold cultures have been kept for as long as twenty-five years under refrigeration by Department of Agriculture chemists. Again mold proves a paradox.

Everyone knows that foodstuffs kept long enough in a house will become moldy. Furthermore, anyone who has seen jelly made and sealed in glass jars may wonder why mold so often is formed on top of the jelly while it is being kept. The answer of the scientists is that mold is everywhere, in the air, in the earth, and on everything with which the food product may come in contact. If you want to prevent mold from forming on jelly, sterilize the glass and seal it hermetically.

Another example of the constant presence of mold in the air is found in two cases of asthma recently traced to mold sensitiveness. The latest case was reported to the American Medical Association by Dr. Harry S. Bernton, of the Georgetown University School of Medicine, Washington, D. C. Dr. Bernton's patient was a young woman who had lived for six years in a damp and musty house, in which it was decided that her nose and throat linings had become sensitized to the particular type of mold that caused her trouble.

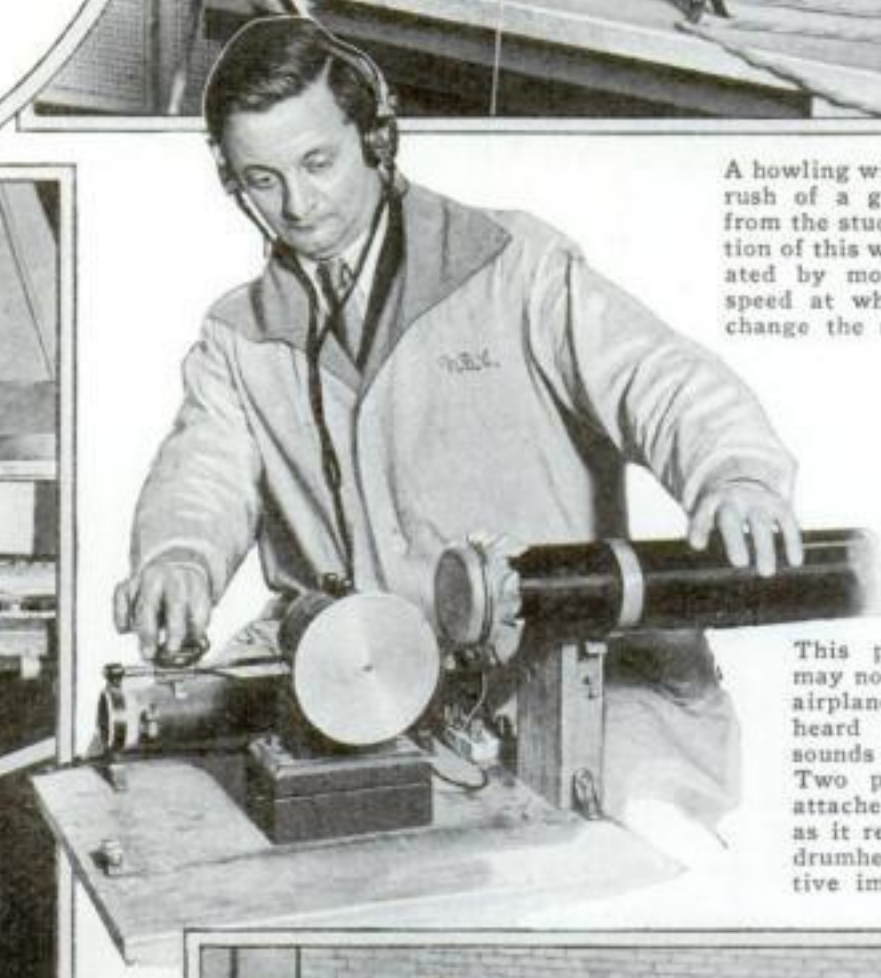
Although only two cases of asthma caused by mold have been found in America, many have occurred in Europe, and American physicians are now giving much attention to mold as a source of asthma. Dr. Bernton studied no less than sixteen forms of mold in tests upon asthmatic patients in an effort to discover the cause of their condition.

The constant presence of mold in the air is further attested by the fact that factories (Continued on page 141)

Strange Devices Make Realistic Noise for Radio Audience

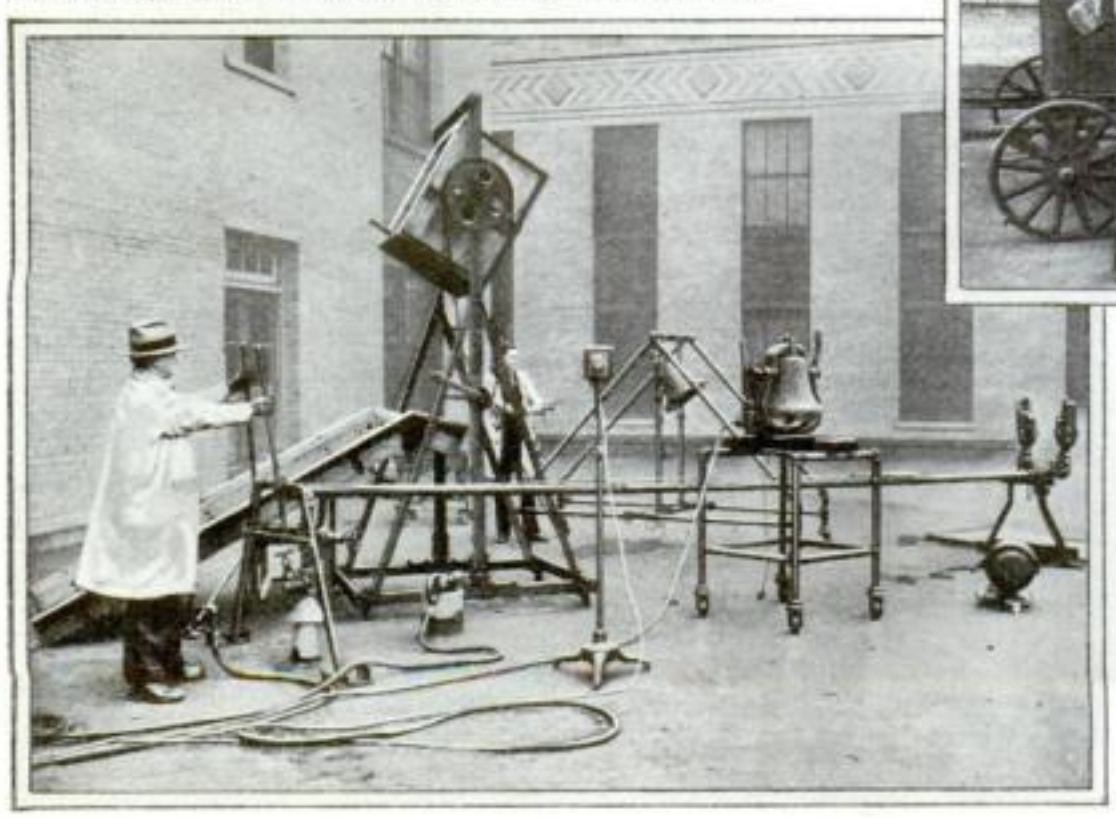
A howling wind or the deafening rush of a great gale goes out from the studio at the manipulation of this wheel, which is operated by motor. Changing the speed at which it rotates will change the sound of the wind.

Producing sound illusions for the radio is an art in itself and elaborate study is necessary to get the desired effects. Here a toy locomotive is being used in a special sound chamber and the noise it makes will go out over the air as the rumble and roar of a big engine tearing along over a well ballasted track.



This piece of apparatus may not look much like an airplane but when it is heard over the radio it sounds exactly like one. Two pieces of cord are attached to the disk and as it revolves they hit the drumhead, giving an effective imitation of a plane.

The wild crashing together of two cars is vividly reproduced for the air by means of a piece of stovepipe with which the glass in an old car is smashed. Thus is obtained the sound of rasping metal and the realistic crash of flying glass.



At left is the apparatus used in the reproduction of a steam locomotive's whistle and bell. To the radio listener the sound is exactly what he would expect to hear if a real locomotive were making the noise outside his window. It has been found that the real thing is not so real over the air as an imitation, and as a result the Chicago experts of the National Broadcasting Company have perfected the devices shown on this page to give with absolute accuracy the desired illusion to the audience listening in by radio.

NATURALIST, POSING AS CACTUS, SNAPS DESERT ANIMALS

No Sherlock Holmes of fiction ever disguised himself with more versatility than Arthur N. Pack, president of the American Nature Association. When this well-known naturalist wants to approach timid animals in their native haunts, without frightening them out of range of his camera, he dons an appropriate costume.

A disguise resembling a giant desert cactus was his creation during a recent expedition through the desert wastes of Arizona along the Mexican border, with William L. and Irene Finley, noted naturalists. Clad thus, shy desert animals walked up to him to be photographed.

Mountain goats, among the most difficult of wild animals to approach, were successfully photographed by Pack. He fashioned for himself a white goat costume with horns and long whiskers.

Pack's use of disguises was suggested by natives of central Africa who creep through the tall grass, wearing a wooden headdress carved to resemble a bird. Pretending to stop and peck, from time to time, the hunter can approach birds and other game close enough to capture them.

At left, Arthur N. Pack is giving a good imitation of a giant cactus so that he can get near the desert animals and photograph them. Above, the disguise worn by an African when after birds.

662-HOUR RUN, RECORD FOR OUTBOARD MOTOR

Two outboard motorboat pilots, O. E. Ellison and L. F. Walker, recently drove their tiny craft around Lake Bradford, Tallahassee, Florida, for nearly twenty-seven and one half days without stopping. Purring along for 662 hours, it finally exceeded by fifteen hours the airplane endurance record established by Dale Jackson and Forest O'Brine, of St. Louis. It is said by outboard experts that this run represents ten years of average life for one of these portable motors.

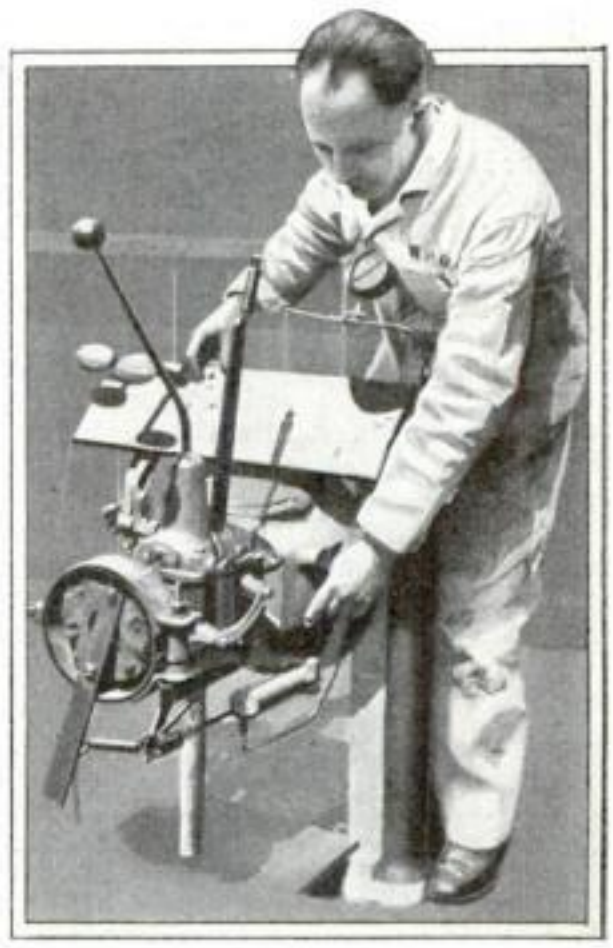
A number of such runs were made in different parts of the country. The data will be used in designing new engines.

ARTIFICIAL AIR TO AID DEEP-SEA DIVERS

Artificial air, a synthetic mixture of gases that can be substituted for ordinary air and used by divers, may speed recovery of gold from the sunken liner *Egypt*, off the coast of France.

Salvage work on this ship, described in this magazine (P.S.M., Dec. '30, p. 47), was interrupted when an explosion wrecked the salvage ship *Artiglio*. Recently, Commander Sloan Danenhower, New York submarine expert, went to France with a proposal to resume salvage operations with the *Defender*, only privately owned submarine. Divers would reach the wreck through a trapdoor in the submarine, breathing artificial air through hoses.

This synthetic atmosphere is the invention of Dr. Willard Hershey, of McPherson College, Kansas (P.S.M., Apr. '30, p. 32). It consists of an artificial mixture of oxygen and helium, which does not produce "bends" as does ordinary air.



EMERGENCY BRAKE FOR CARS IS AUTOMATIC

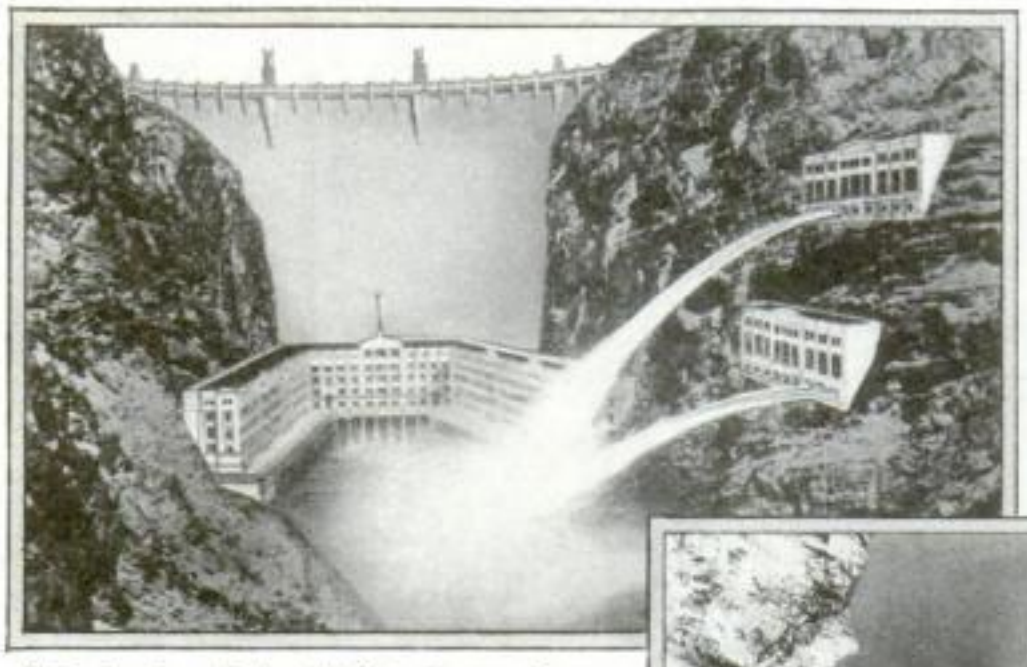
An automatic emergency brake for autos has been designed by W. J. Obidine, garage owner of Los Angeles, Calif. Accidents caused by the failure of the regular brakes at critical moments led him to make experiments that resulted in his device, which consists of a tube system connected with the manifold and a piston cylinder to motivate the brake.

As long as the regular brakes work, the emergency brake does not function; but if they fail, the pedal pressed to the floor touches a valve button that actuates the emergency brake, which can be set to bring the car either to a slow or abrupt stop. Pressing the valve automatically works this brake.

In the picture above Obidine is holding the valve button between right thumb and finger and pointing to the piston cylinder with his left hand. The brake, the inventor says, can be installed in any car equipped with hydraulic, air, or mechanical brakes.

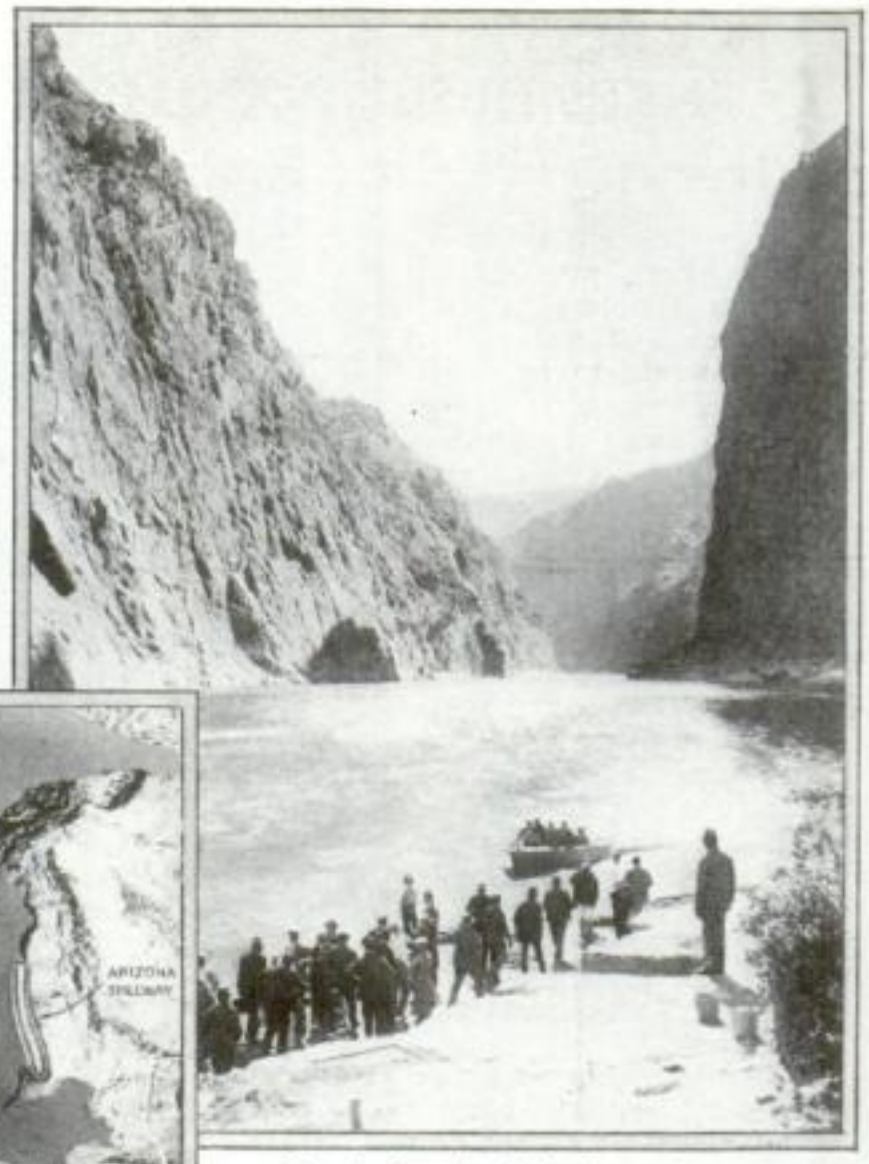
In this outboard motorboat, O. E. Ellison and L. F. Walker circled around Lake Bradford, Tallahassee, Fla., for 662 hours without stopping the engine, thus setting a new record.

WORK ON WORLD'S HIGHEST DAM MAY START THIS SUMMER



This drawing of the 587-foot Hoover Dam was made on an actual photograph of the site.

This airplane picture of dam's site also has drawings of spillways and power houses.



Here is the site of the Hoover Dam, world's highest. Arizona on left, Nevada on right.

Some time soon, engineers plan boldly to divert the entire Colorado River through four huge tunnels in its rock walls. They will not let it back until they finish Hoover Dam, which will tower higher than the Washington Monument. Final plans for the dam have just been made public by the Government, in asking for bids.

Preliminary work already has commenced. Actual construction of the dam should be under way this summer after years of discussion and debate. When completed it will serve the three-fold purpose of power, water supply, and flood control.

Originally known as Boulder Dam and renamed in honor of the President, this structure will be nearly double the height of the highest dam in existence today. It measures 730 feet from the bottom of its foundation to its crest, and towers 587 feet above the present water level.

SIX WATERSPOUTS ALL ACTIVE AT ONCE

Waterspouts were active in a big circle when this remarkable photograph was taken. The unusual phenomenon was witnessed in the Sulu Archipelago, between Sandakan, British North Borneo, and Sitangkai. To see even one waterspout is remarkable; to see six working all at once, sweeping into the air immense columns of water that whirl at a dizzy speed, probably is unprecedented in the experience of any observer. The spouts are caused by a vortex of superheated air, revolving at high velocity, the point of which touches the water and sets it in motion.

One of the most remarkable photographs ever made shows six big waterspouts all whirling madly at the same instant. The picture was taken during a storm in the Sulu Archipelago.

FOOT PUMP FOR AUTO HAS TWO CYLINDERS

By giving this foot pump two cylinders, dividing the pressure, its operation is easy.

A new auto tire pump operated by foot power is a convenience for motorists. Power is applied to its plunger by an angular foot lever mounted on one end of the pump frame.

Instead of compressing all the air in one cylinder, this pump draws it into a large cylinder, partly compresses it, and then passes it into a smaller cylinder that completes the compression, from which it goes to the tire.

The pistons of both cylinders are mounted on the one plunger. Dividing the work of pumping into two stages like this makes it easy for women drivers to pump up the heaviest tires.

The pump is equipped with a push-on connector that fits all valves, and attached to its tube is a pressure gage through which the air must pass on its way to the tire.

Winners in December "What's Wrong?" Contest

Judging the entries in *Popular Science Monthly's* successful *"What's Wrong?"* contest was a big job that required the attention and labor of skilled and diligent judges. Each letter in which the mistakes in the pictures were listed was given careful consideration and checked against the actual mistakes to make sure that each contestant received justice.

FIRST PRIZE 500 DOLLARS
C. K. Holsinger, Emporia, Va.

SECOND PRIZE 100 DOLLARS
Mrs. C. R. Kenyon, Adams, Wis.

THIRD PRIZE 50 DOLLARS: Gerald H. Denison, Detroit, Mich.

TEN PRIZES OF TEN DOLLARS EACH

G. L. Brewster, Evanston, Ill.
Edwin G. Cook, New Lisbon, N. J.
William Geer, Pueblo, Colo.
F. D. Haines, Dutton, Mont.
Albert H. Hainsworth, Wickford, R. I.
Frank Harvey, New York City, N. Y.
Otto Kroeger, Jefferson City, Mo.
Ruth B. MacArthur, Long Beach, Cal.
E. L. Moorhead, Pearl Harbor, T. H.
H. R. Streaker, Los Angeles, Cal.

FIFTY PRIZES OF FIVE DOLLARS EACH

Mrs. K. E. Anderson, Bowling Green, Ky.
Earl P. Barker, Wilmore, Ky.
H. W. Baxter, Davenport, Iowa
Joseph A. Bieke, Detroit, Mich.
V. E. Bock, Waterloo, Neb.
A. P. Burns, Worcester, Mass.
Hyman Burwick, Worcester, Mass.
Munroe Carlton, Effingham Falls, N. H.
Mrs. John Chihuly, Jr., S. Prairie, Wash.
Shelby L. Davies, Portland, Ore.
R. A. DeLadurantaye, Detroit, Mich.
Chas. E. Eck, Highland Park, Mich.
Roscoe Farnsworth, Cecilville, Cal.
J. H. Field, Fayetteville, Ark.
R. P. Glenn, Abilene, Tex.
A. L. Hammond, Haverhill, Mass.
W. I. Harding, Philadelphia, Pa.
A. E. Heatherington, Orlando, Fla.
William F. Hibbard, Weiner, Ark.
Charles D. Hild, Washington, D. C.
Daniel L. Higley, Nixon, N. J.
Leonard C. Houser, Pagosa Springs, Colo.
Walter J. Irvin, Jr., Reidsville, N. C.
Henry Jensen, Fort Dodge, Iowa
Harold L. Johnson, Shavertown, Pa.
Harry Johnston, Detroit, Mich.
S. C. Kenyon, Flint, Mich.
Glenn W. Knight, Rock Island, Ill.
W. F. Krentel, Shreveport, La.
Eva M. Linscott, S. Lancaster, Mass.
F. J. McDonald, Norwalk, Cal.
Lena Jane Merrill, Wood, S. D.
Edward L. Milgate, Utica, N. Y.
E. Morgan, Chicago, Ill.
James C. Phelps, Port Jefferson, N. Y.
F. G. Piepenbrink, Ft. Wayne, Ind.
B. M. Plaskett, Hollywood, Cal.
Harold W. Readen, Anderson, Ind.
Robert Rippe, St. Louis, Mo.
C. S. Robinson, Atlanta, Ga.
E. R. Roeske, Valders, Wis.
E. H. Rust, Denver, Colo.
Z. Sekine, Los Angeles, Cal.
A. H. Seymour, Lincoln, Neb.
Vernon B. Shipley, Neodesha, Kan.
William Stachowiak, South Bend, Ind.
Syd. Verts, Stuart, Fla.
S. Wallwork, Athol, Mass.
W. F. Weisel, Hampton, N. J.
A. D. Zimmerman, Blue Mound, Ill.

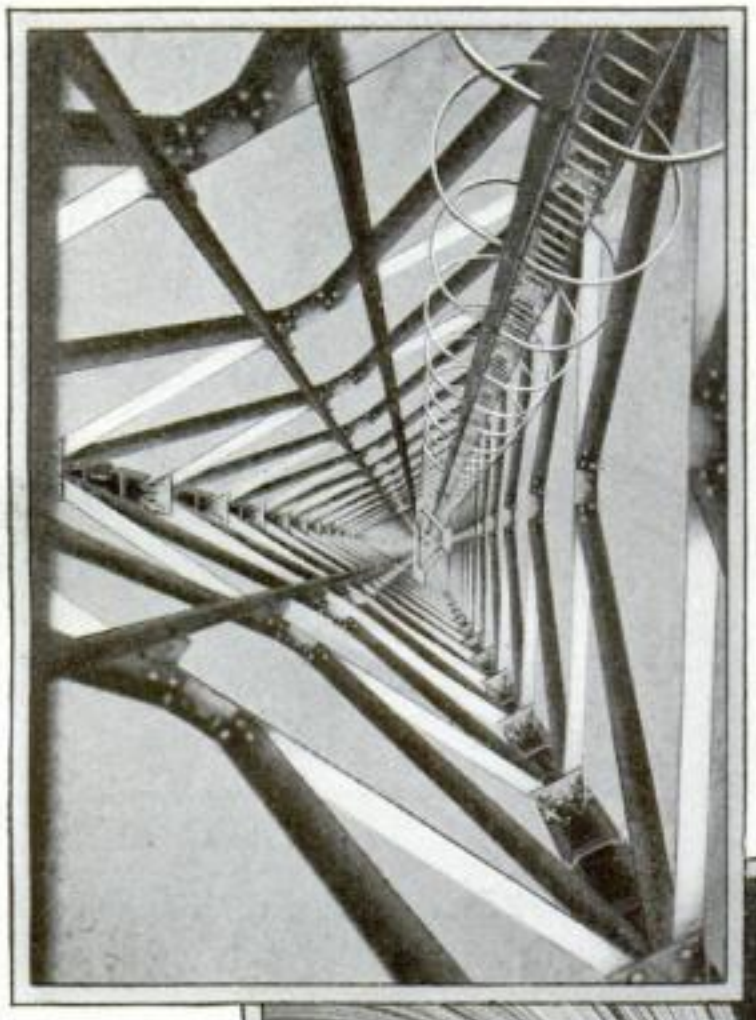
Final List of Contest Prize Winners to Be Published in April

FROM every state in the Union, from the island possessions of the United States, and even from Australia, entries have poured into the office of POPULAR SCIENCE MONTHLY during the final days of the great George Knowitall "What's Wrong?" contest. The ludicrous blunders of the well-meaning George in his attempts to show his friends "how to fix it" have provided fun and profit for a host of our readers.

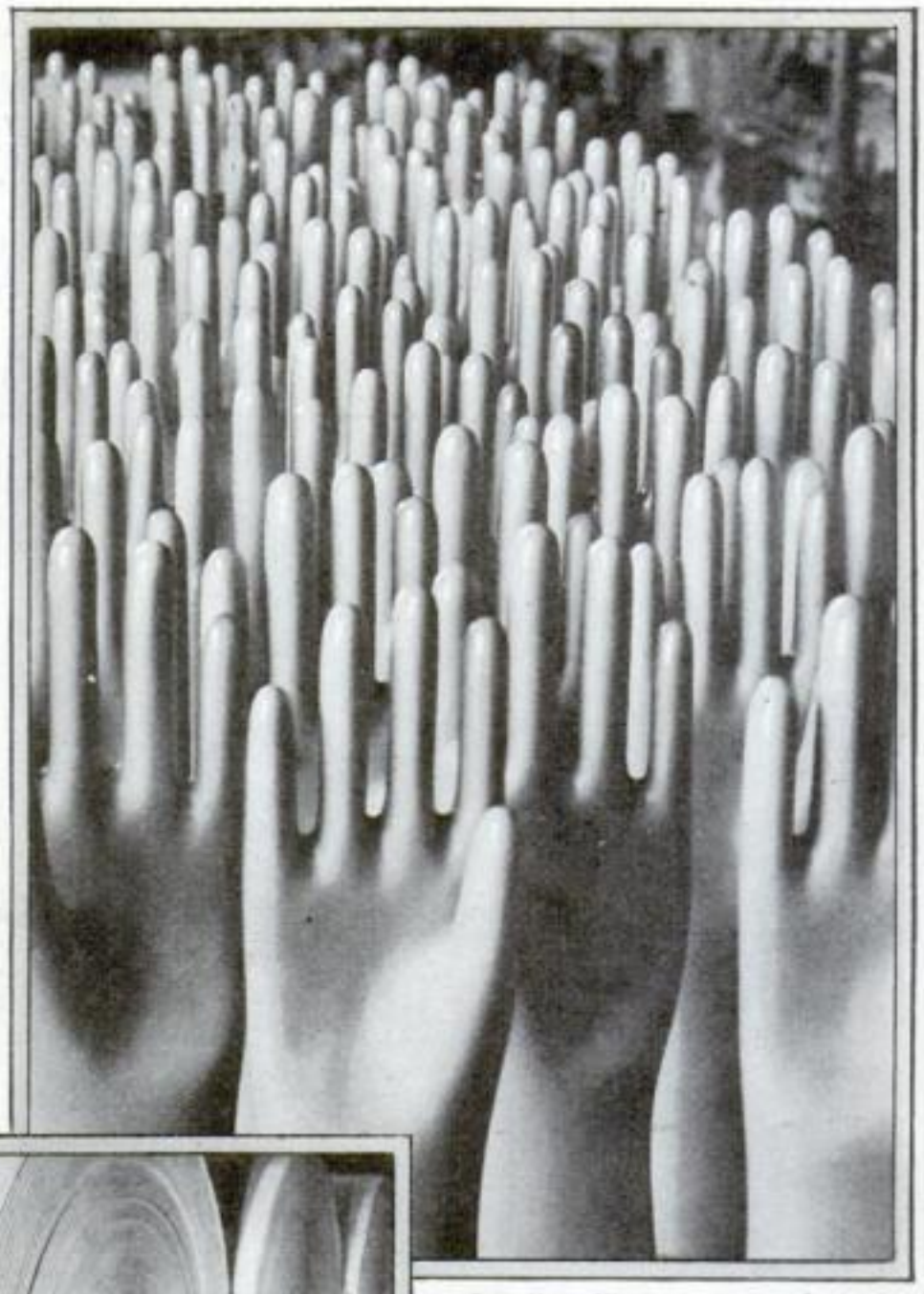
The interest aroused by this unusual contest is proved by the flood of entries coming from cities, villages, farms, and even from battleships on the high seas. Letters of appreciation for the enjoyment which these brain-teasing pictures have given have been received from many who did not enter the contest for one of the many cash prizes, which totaled $4,000.

The winners of the cash prizes in the December contest are given above. The results of the January contest will be published next month. Watch for the April issue of POPULAR SCIENCE MONTHLY. It will carry good news for those who have followed the adventures of George.

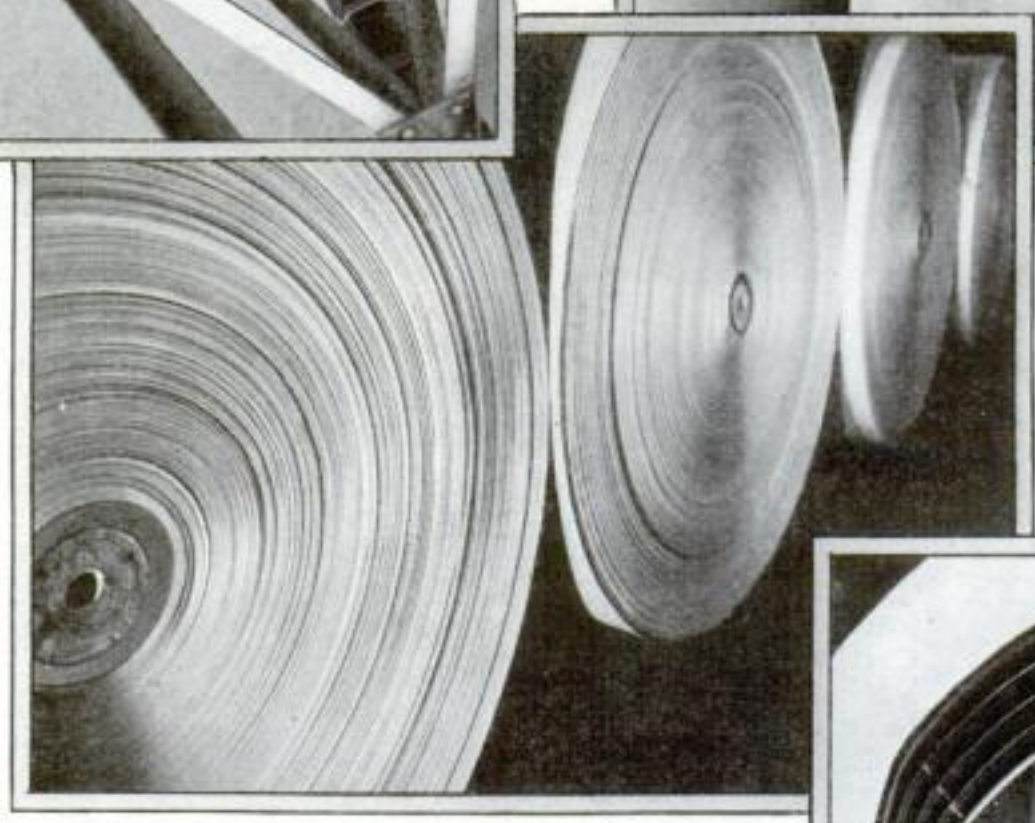
Weird Futurist Designs Found by Camera in Modern Industry



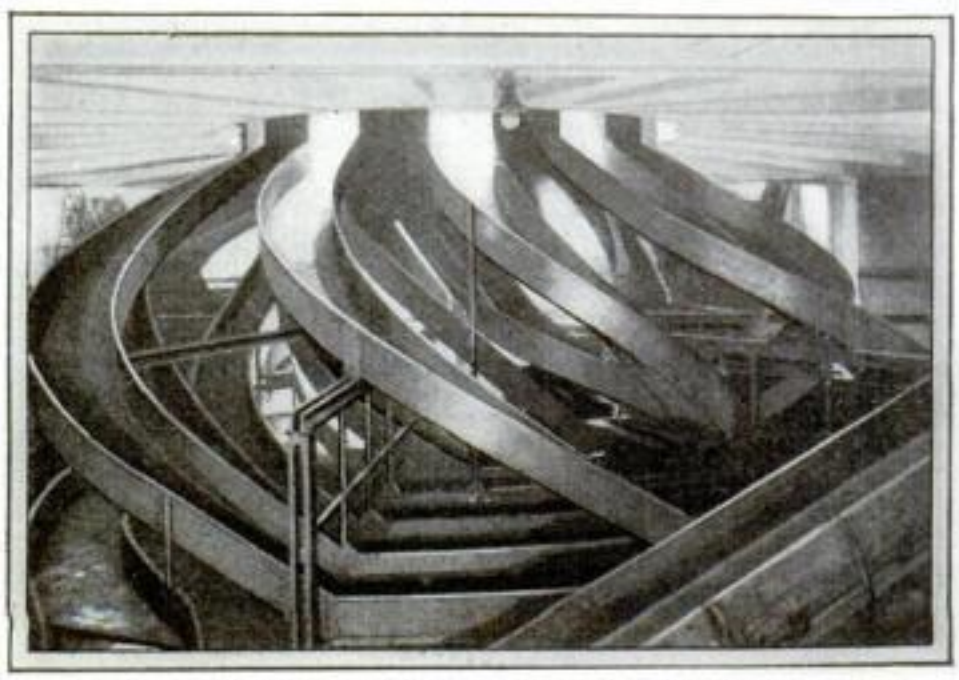
You may get lost in the dizzy maze of triangles shown above, but it is only one of the surprising modernistic designs now found in the world of machines. This shows what you would see if you looked down one of the 820-foot masts of the Rugby, England, radio station.



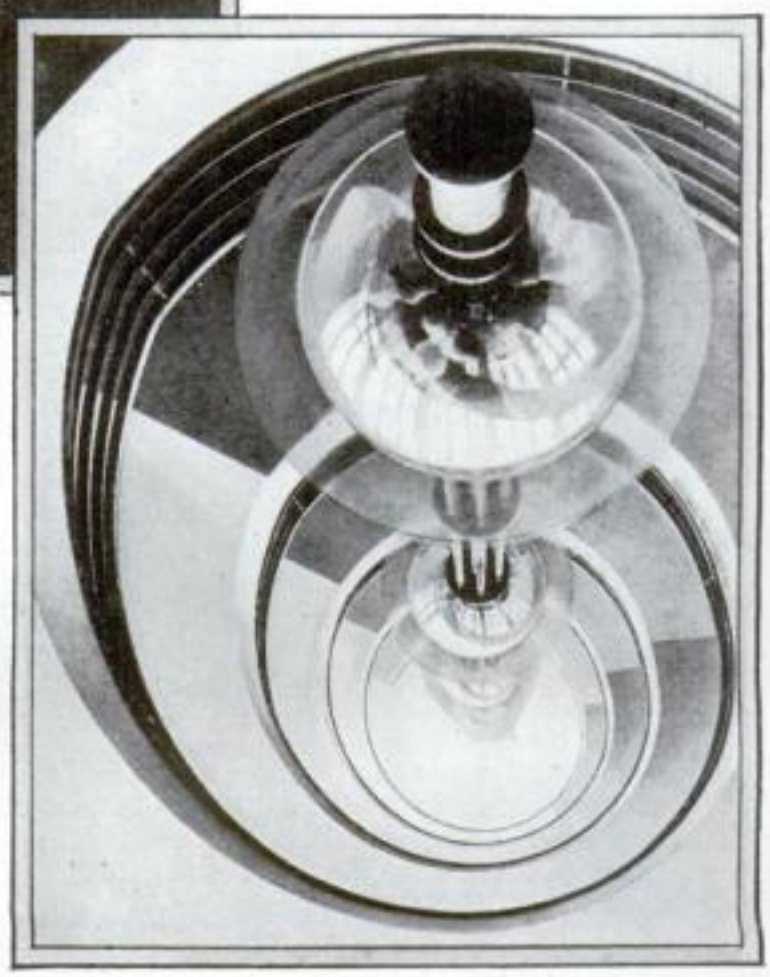
Standing like an army of gnomes drawn up at attention, the rigid fingers of these rubber gloves gave the photographer a highly futuristic picture. The gloves, stretched on forms after dipping, are being sent to the vulcanizing room to receive final treatment before leaving the factory.



They look like whirling disks with concentric circles giddily revolving, but actually they are what the camera saw when it photographed rolls of paper in a printing plant.

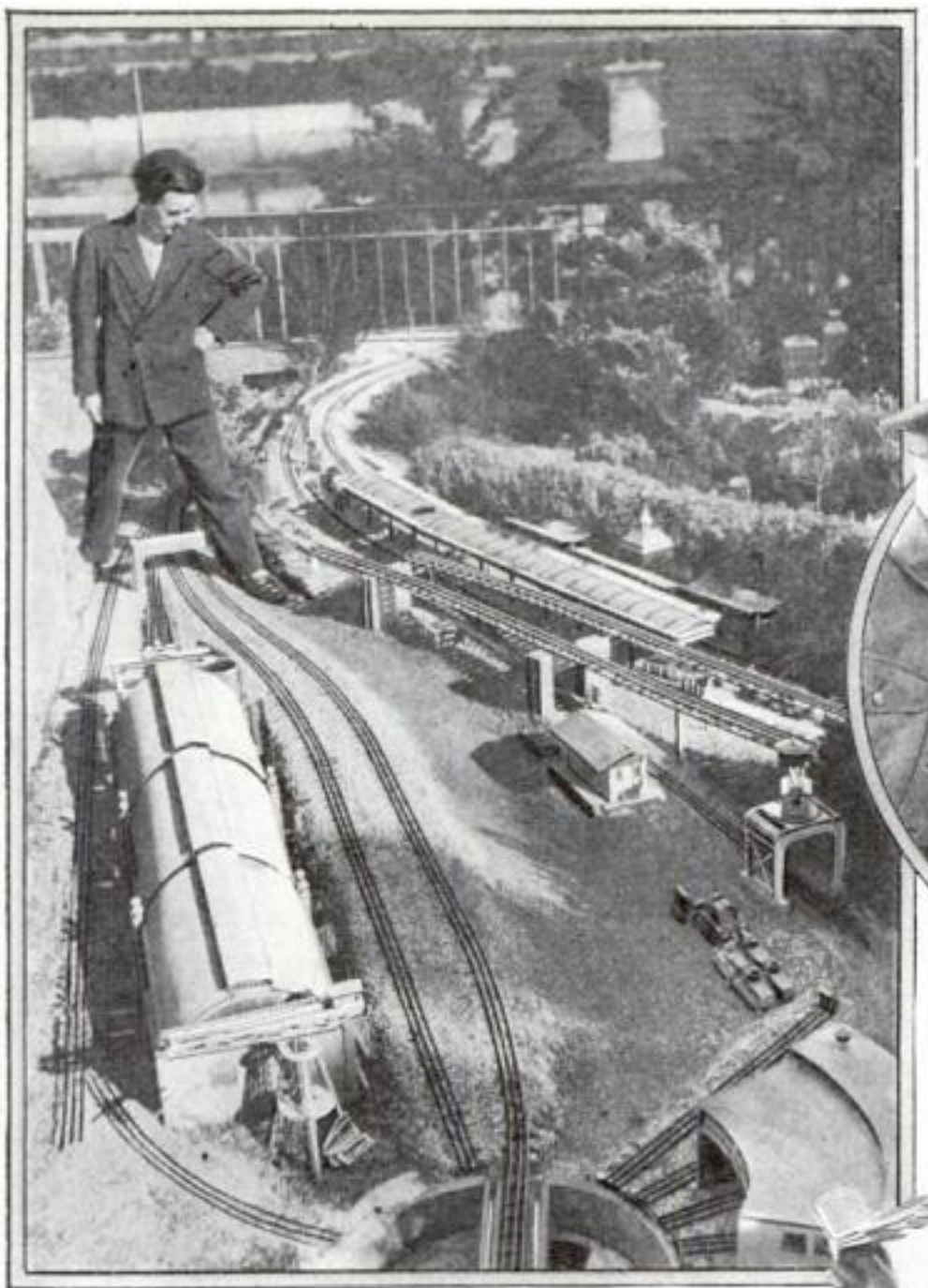


Curiously suggestive of the long leaves of tulip plants are these slender steel chutes that spiral downward in a German post office.



This is not a futurist drawing of a ballet dancer, but an unusual photo of a spiral staircase and lights.

New and Rare Triumphs Won by Model Makers

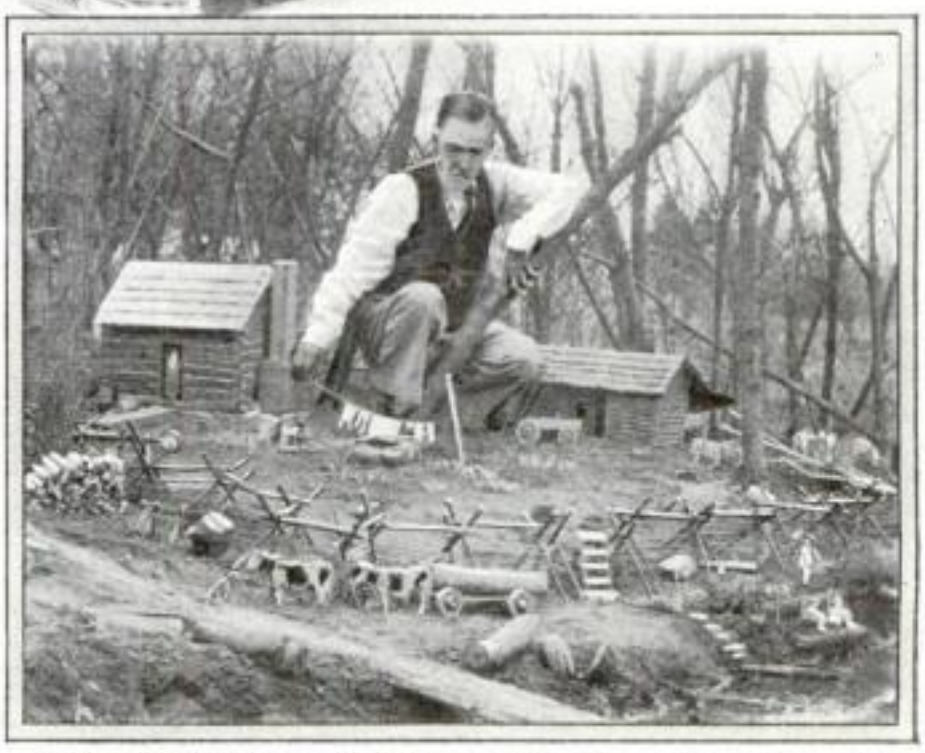


A RAILROAD PRESIDENT. Rene Claude, son of Georges Claude, who has built a plant to extract power from the sea, is seen here with a railroad he built at his home near Paris. Rene is president of the French Association of Amateur Railroaders.

THERE'S ONLY ONE. This eighteen-cylinder aero engine is the only one now in existence. It was built by G. Smith, right, of London, and shown at the Model Engineering Exhibition. There are three thousand parts in the engine.

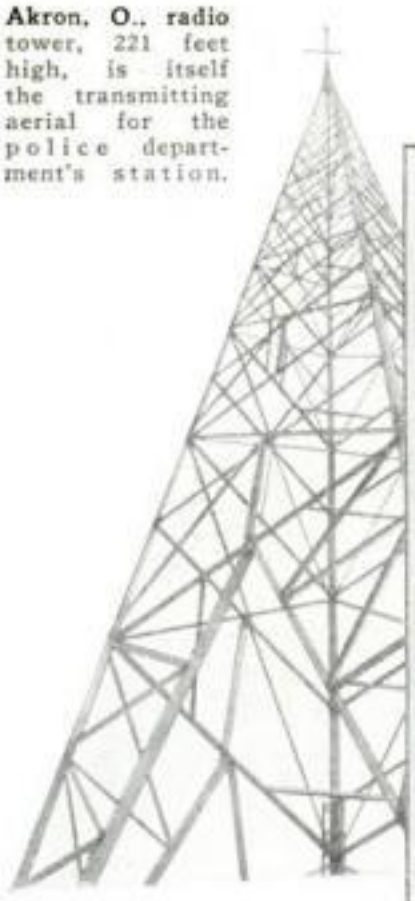
TESTED IN FLIGHT. Models of a new airplane wing, right, designed by Rene Chenet, French engineer, were tossed recently from the top of Eiffel Tower, Paris, to study the steadying effects of air ducts in the wing.

WORLD'S SMALLEST TRAIN. With gold parts so tiny as to be barely visible to the naked eye, J. Martin, of Walthamstow, England, has made a train which he claims is the smallest ever built.



PIONEER DAYS BROUGHT BACK. This miniature log cabin, with rail fence and ox-drawn prairie schooner, was built by Adam O. McNatton, of Columbus City, Iowa, and is of soap and dough.

RADIO TOWER SERVES AS BROADCASTING AERIAL



Akron, O., radio tower, 221 feet high, is itself the transmitting aerial for the police department's station.

At right, a close-up at the bottom of the tower showing the eight-foot porcelain insulators.

A 221-FOOT broadcasting tower recently erected in Akron, O., may be the forerunner of better radio programs. Unlike other radio masts, it does not support one end of a system of wires but is itself the antenna.

The height of the tower is carefully proportioned to the length of the wave emitted by the station. Each of the four legs of the tower rests on a base made of steel and special eight foot porcelain insulating tubes. Since joints in a steel tower are not always electrically perfect, the "radiating tower" is assisted in its broadcasting of signals by four vertical wires hung from the top. They are carried on a crosstree which may be moved up or down in order to "tune" the tower to exactly the right wave. Instead of absorbing and wasting some of the station's power, as ordinary masts do, the new one puts it all to work.

Following the success of this tower, designed for the Akron police department, it is reported that one of the large broadcasting systems is erecting a 600-foot "radiating tower" in New York.

MOTHER INVENTS MARBLE SHOOTER FOR SON

HER son's torn stockings from kneeling to shoot led Mrs. Nora D. Payne, of New York, to invent this automatic marble shooter which resembles the gear-shift lever of a car. A marble is placed in the receptacle at its base and shot out when the handle is tapped.

NEW MICROSCOPE PRYS INTO SECRETS OF CELL

A MICROSCOPE that reveals details of cell structures never before seen is the invention of Charles Spierer, a Swiss scientist. Light is directed downward onto the object from a tiny mirror of gold or platinum on the upper side of the lowermost lens. From the object the light is reflected back to the observer's eye.

MOTORBOAT DRIVEN THROUGH FLAMES

RESIDENTS of Miami, Fla., were treated the other day to the unusual spectacle of an outboard motorboat leaping through flames. Roaring across the bay to get a good start, Malcolm Pope, pilot, headed his craft straight at a blazing framework mounted on a float anchored off Miami Beach. Going at full speed the boat leaped into the flames and shot out on the other side. Neither the driver nor his craft was harmed by the fiery ordeal.

Malcolm Pope of Miami, Fla., as he appeared at the instant his motorboat plunged from the flames into which he had driven it.

NAVY CLOCK IS HIGHLY ACCURATE

How would you like a watch or clock that wouldn't gain or lose more than one hundredth of a second each day? The United States Navy recently obtained an electric clock accurate within these limits for its Washington, D. C., observatory.

A wooden case resembling those used for old-fashioned grandfathers' clocks has three clock faces on its upper part. Below these a pendulum swings, in step with a master pendulum in a vacuum tank at the right. Working the pendulum in a vacuum insures greater accuracy in its stroke, as there is practically no air resistance to cause variation.

This amazingly accurate time recorder will be used by astronomers working at the naval observatory, and will keep time between telescope observations by which all clocks are set.

The photograph shows Paul Sollenberger, Chief of the observatory's time service, inspecting the precise clock.

Its pendulum swinging in a vacuum, this clock is accurate to within .01 second a day.

SAND BOX ON BUMPER MAY END SKIDDING

AN INVENTION to take the skid out of driving has just been made by C. W. Nordquist, of Minneapolis, Minn.

The apparatus consists of a combination hopper and front bumper, filled with sand, so designed that it can be operated either from the steering post or by pressure on a foot pedal, thus spraying a column of sand in front of the front wheels.

Dry sand is placed in the hopper which is divided by a vertical partition into two parts each of which supplies sand for one front wheel. The bottom of the hopper slopes downward from the center. The vibration of the car causes the sand to flow toward the delivery spouts.

MODELS OF PIGS HELP BUYER PICK GRADE

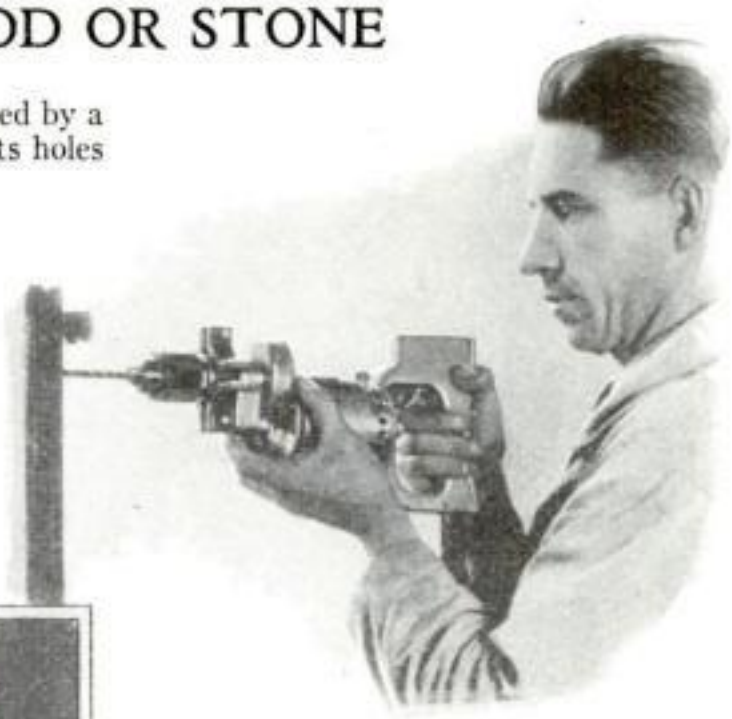
WHAT kind of pig will you have? Livestock buyers can take their choice from clay models made by Mrs. Justine Warner, an artist in the Department of Agriculture. Each clay pig represents one of the six different grades of such animals established by the Government for the guidance of dealers. The Department grades pigs as prime, choice, good, medium, common, and cull.

The painted models, it is said, leave no doubt as to what the Government means by a "prime," "choice," or "good" pig. Twenty-five sets of these models have been shipped to dealers throughout the country. Agricultural colleges have asked for sets as an aid in classroom work.

DRILL CUTS WOOD OR STONE

A PORTABLE electric drill developed by a Chicago, Illinois, manufacturer, cuts holes in wood, metal, or concrete. It uses ordinary twist drills for wood or metal work, and "star" drills for cutting holes in masonry. An attachment used in connection with the star drills gives the tool an up and down hammerlike motion as well as a rotary one. Holes up to seven eighths of an inch in diameter can be cut in concrete, brick, or stone.

The portable drill shown above is being used to bore in concrete; it will also cut stone.



Being a versatile tool this drill, above, can drill into wood as easily as into concrete.

AIR CURRENTS CAUSE DUST LINES ON WALL

HAVE you ever wondered why dust collects on the walls along the lines of laths and joists behind the plaster? Professor William J. Hooper, of Battle Creek College, Mich., found that the spaces between laths are usually a little hotter or colder than the plaster. This difference of temperature affects the movements of tiny air currents on the surface of the plaster. If all parts of walls or ceilings were kept at the same temperature no lath marks would occur.

PLANS TWO ELEVATORS FOR ONE SHAFT

How office workers of the future may ride to and from their places of business is shown by the model of a two-car elevator shaft constructed by Doctor Frank J. Sprague, well-known electrical engineer and pioneer elevator designer. Passengers for upper floors will take a car that runs ahead of the local car, which carries passengers for lower floors only. Separate drums and cables will hoist the "express" and "local" cars independently, passengers boarding the "express" on the first floor and the "local" in the sub-basement.

The two-car elevator is like a railroad, with express trains running ahead of the locals. Electric safety devices patented by Doctor Sprague will keep the two cars from crashing together or overspeeding. Sprague's safety device is also designed to stop the car and hold it suspended so it cannot fall in case the cable operating either express or local breaks. This idea, it is said, will save space now devoted to elevator shafts in tall buildings.

Pigs modeled in clay designed to show buyers exactly what Government means by its grading of these animals.

Dr. Frank J. Sprague, New York, exhibits his special elevator shaft designed for two cars.

SOAP BUBBLES TEST PLANE'S STRENGTH

GOVERNMENT airplane research engineers at Washington, D. C., recently hit upon the idea of using soap bubbles for testing the strength of plane parts. An opening the exact size and shape of the part under test is cut in a thin metal plate. Using a small wooden tool, engineers sweep a thin soap film over the hole as the plate is held between two metal forms. A light pressure of air is then applied under the film, blowing it up slightly over the hole.

It has been found that the contours of the bubble formed over the opening correspond closely to the twisting effect that airplane spars are subjected to while in flight. Thus careful measurement of the shape of the bubble gives a good idea of the strength of the part under observation.

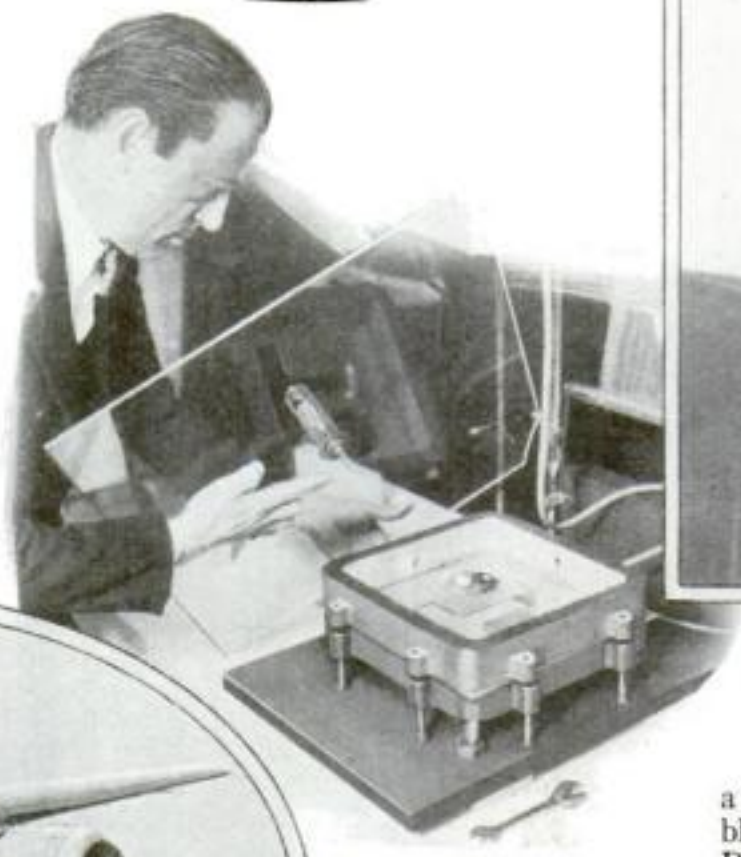
NAVY GETS AUTOGIRO

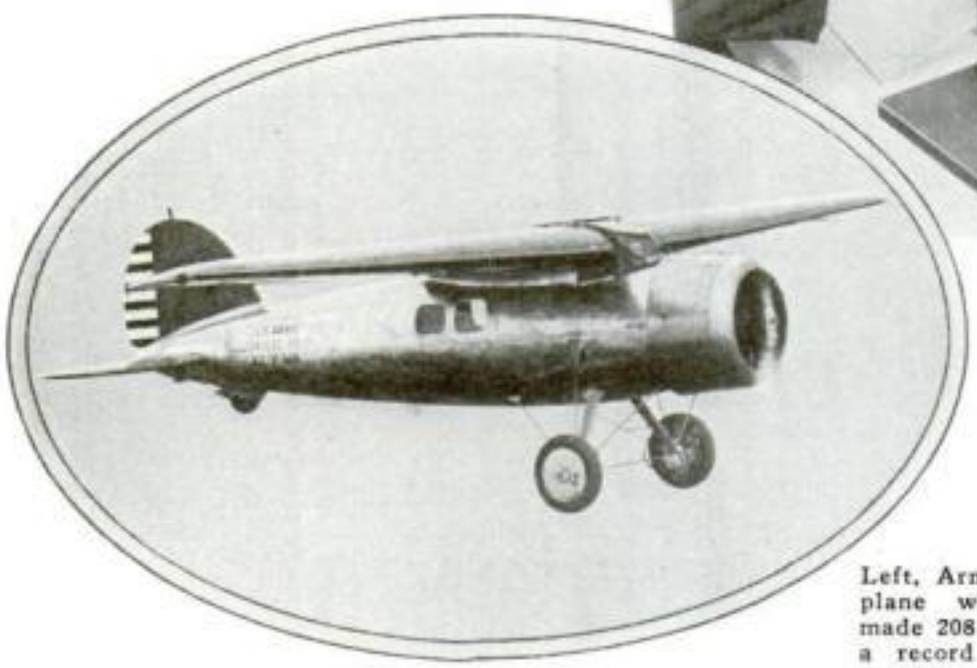
THE Navy's next patrol and observation plane may be an autogiro. One of these "flying windmills," similar to those described on page twenty-eight of this issue, was recently demonstrated before aviation officials at Bolling Field, Washington, D. C. As a result, the Navy Department announces that it plans to buy one of them for tests.

FASTEST ARMY PLANE HITS 208-MILE CLIP

EXPERIENCE gained in constructing the planes used by Miss Ruth Nichols and Captain Frank Hawks on their record-breaking transcontinental flights has enabled a Detroit, Mich., aircraft manufacturer to build a new speed plane for Brigadier General J. E. Fechet, chief of the United States Army's air forces. Said to be the fastest Army plane in this country, the new speedster made 208 miles an hour in trial flights.

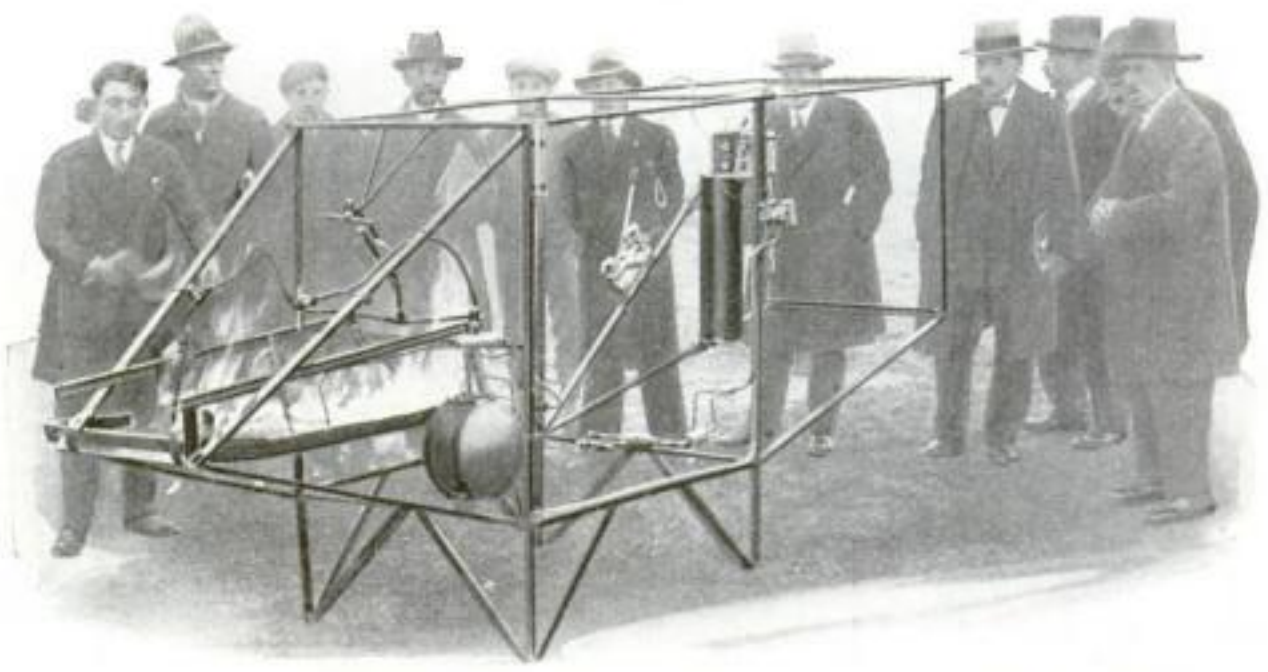
It is a cabin monoplane with the cockpit at the center of the wing.



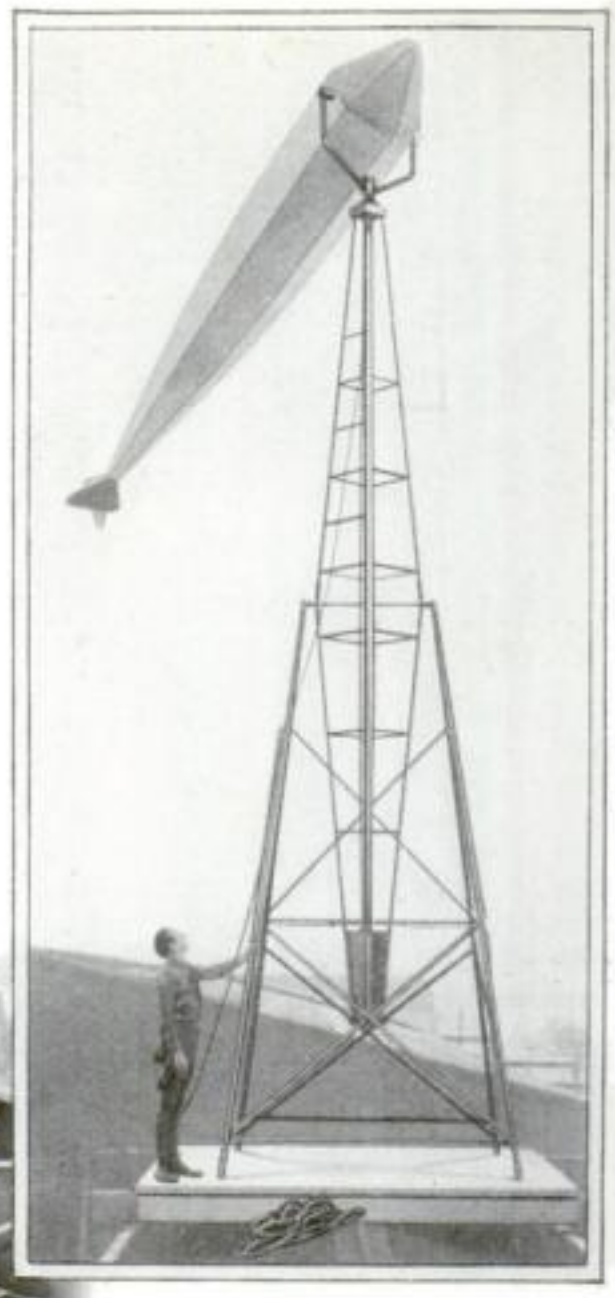


Measurement of a soap bubble raised over an opening exact shape of airplane part to be tested shows twisting strain the part meets in flight.

Left, Army's new speed plane which in tests made 208 miles an hour, a record for its type.



An automatic fire extinguisher for airplanes was tested in a stripped frame. A thermostat, actuated by heat, opens nozzles and sprays over the craft a liquid that kills the flames.



WIND INDICATOR LOOKS LIKE ZEP

A SEVENTEEN-FOOT "Zeppelin" atop a steel mast tells which way the wind blows at Bolling Field, Washington, D. C. Illuminated at night and visible at great distance, it is being tested by Government meteorologists to see whether it may prove superior to ordinary weather vanes or "wind cones." The indicator, three feet in diameter, is hung so that it is free to revolve with the wind or to swivel up and down.

CHICKENS GUIDE PILOTS

Cows and chickens warn aviators who fly regular cross-country routes when they are off their course, according to officials of a midwestern field. Pilots noticed that animals paid no attention to their planes on their regular runs, where aircraft were a familiar sight. But when the pilots missed their course, livestock on farms were visibly excited by the planes.

TEST AUTOMATIC FIRE FIGHTER FOR PLANE

FIRE hazard in the air is reduced by an automatic fire extinguisher for airplanes, recently demonstrated at Orly, France. Located in important parts of the plane are coils of tubing, connected through pipes to the brains of the device, a sensitive thermostat. Fire gives its own alarm by heating the air in the tubes Response is immediate. Sprays of fire-extinguishing liquid spurt against the flames from a number of nozzles strategically placed.

V-SHAPED PLANE HAS LOW LANDING SPEED

AN ODD-LOOKING tailless biplane recently was flown successfully at Miami, Fla. The unusual little ship was developed by the late Glenn Curtiss, pioneer aircraft manufacturer, just before his death. He planned a craft that could, he hoped, be manufactured at a price that would put it within reach of the average motor car owner, and that would have many safety features as well. It is said to be impossible to loop, spin, or dive the plane, which has a landing speed as low as nineteen miles an hour.

The wings are brought to a point amidships, giving the plane a vee-shaped appearance resembling the folded paper darts made by boys for throwing into the air. Power is supplied by a three-cylinder motor that turns a pusher propeller at the rear of the short fuselage. Two rudders are mounted at the sides, between the wings. A Miami manufacturer is said to have started making these planes.

V-shaped plane, designed by the late Glenn H. Curtiss, was successfully tested in Florida.

NOISELESS PLANE NOW PLANNED

THE fact that under some circumstances loud noises can kill each other may be applied in a "ghost" airplane that would be silent. This idea was recently reported to the British Air Ministry by M. D. Hart, aeronautical engineer who has worked out the details of such a craft.

Physicists know that two organ pipes placed side by side, emitting notes of exactly the same pitch, may cancel each other's sound. Hart proposes to connect the "ghost" airplane's exhaust pipe with special pipes of suitable length to make the exhaust of each cylinder cancel the sound of the next. The propeller, another noisy part of an airplane would be made of four rather thin blades spaced so that each blade would have its sound stifled by that of the next one.

DESIGN INSTRUMENTS FOR GLIDER PILOT

GLIDERS, the motorless craft of the air, may soon have a set of instruments as complete as those now found in airplanes. Pioneer experiments are being made by the Standard Glider Club, of Washington, D. C., with instruments especially designed for gliders.

David Parker, Washington's youngest glider pilot, recently tried out a motorless craft fitted with an air-speed indicator like that used by airplanes, except that the dial is modified to give a larger reading because of a glider's slow speed. Now each club member gets a "flight ticket" after a soar, showing just what his air-speed performance has been.

Most unusual of the instruments tested, perhaps, is a "stall warning indicator." When the glider is moving at safe speed, the wind forces a disk backward against a spring. Slowing of the glider allows the disk to advance, closing two silver contacts. Then a bell or buzzer behind the pilot's back warns him to "nose her down" before the craft stalls.

David Parker, of Washington, D. C., experiments with a speed gage, between his feet.

This air-speed indicator designed for use in gliders shows take-off and landing speeds of craft.

Johanna Busse, of the Standard Glider Club of Washington, D. C., tries out the stall warning device, the attachments of which are behind her.

TWO-SEATER PLANE HAS ONE COCKPIT

A MINNESOTA teacher of aeronautics gave his students an unusual demonstration of putting theory into practice. In his spare time, John Akerman, head of the aeronautical engineering department at the University of Minnesota, designed a "chummy" two-seater plane in which pilot and passenger sit side by side as in an automobile.

Not content with his paper plans, he had the machine built at Minneapolis, Minn. It could be produced commercially, he says, at a cost within the limits of the average man's purse. The plane is twenty-two feet eight inches long, with a wing spread of thirty feet. It is built low, being only four feet nine inches high.

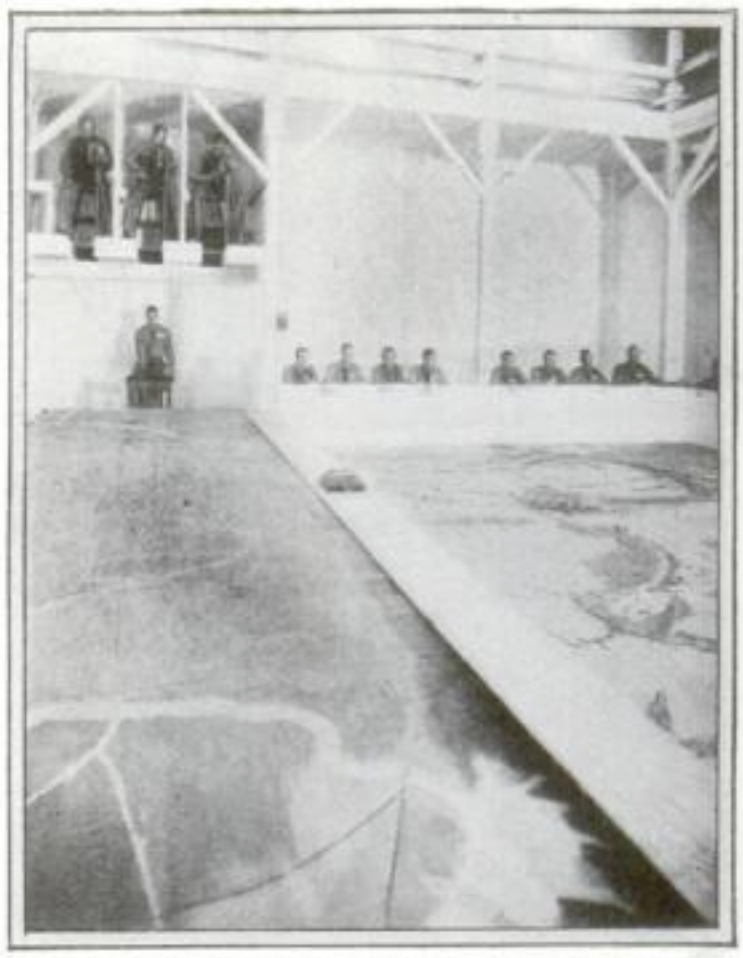
The curious little monoplane has a single cockpit and is powered by a three-cylinder engine turning a "pusher" propeller. It has an uncovered fuselage, the spars of which act as a guard for the propeller, preventing it from accidentally striking anyone on the ground. A large spar extends from the bottom of the cockpit to the tail, acting as a backbone or "keel," giving strength and rigidity to the little plane. Akerman is a native of Russia and did his first flying in that country.

USE MOVING MAP TO TRAIN BOMBERS

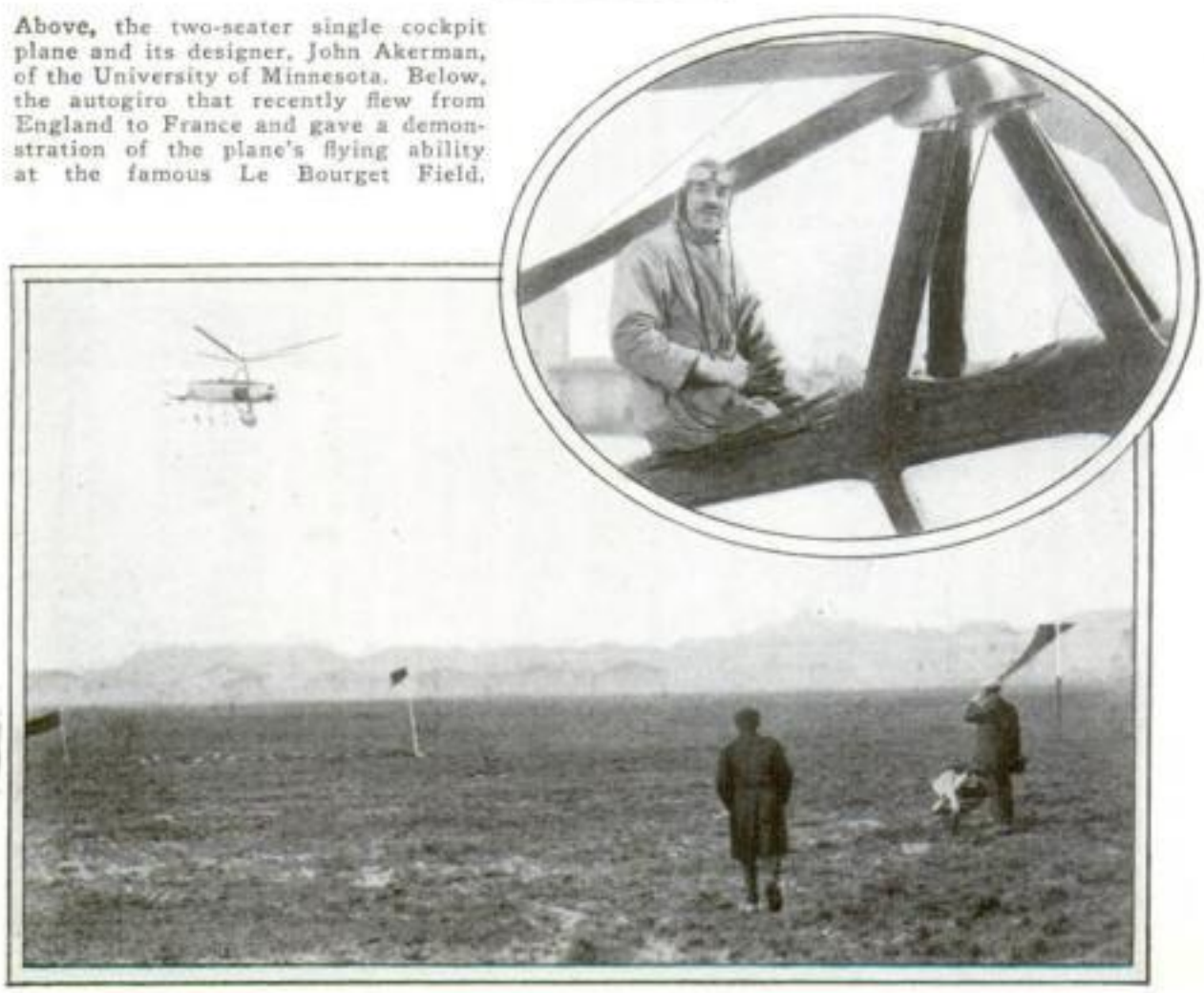
A LARGE map painted on cloth and stretched over rollers enables flyers to practice aerial bombing indoors at the United States Army's flying school at Kelly Field, Texas. Rotating the rollers moves the map under students seated in booths a few feet above it.

They sight at designated points on it through bombing sights like those fitted in Army planes, and release bomb-catches when they think they have sighted the target. The instructor checks their accuracy from a central desk, connected by wires to the students' booths, as shown in the picture at the right.

Towns, rivers, bridges, crossroads, railways, and dams—targets at which Army bombers usually aim—are painted on the "miniature bombing range" in realistic manner. Combined with its motion this gives student flyers a good impression of what they would see from an airplane that was flying at an altitude of 5,000 feet.



Seated above moving map, Army flying students at Kelly Field, Texas, practice dropping bombs.



Above, the two-seater single cockpit plane and its designer, John Akerman, of the University of Minnesota. Below, the autogiro that recently flew from England to France and gave a demonstration of the plane's flying ability at the famous Le Bourget Field.

DILUTED HYDROGEN MAY FLOAT NEW AIRSHIP

NAVY airships today are filled with nothing but helium, safe airship gas that cannot burn. Hydrogen, a slightly lighter and highly inflammable gas such as was used in the ill-fated British airship *R-101*, is ruled out. But Navy officers are now considering the possibility of mixing helium and hydrogen to give their new super-airships, under construction at Akron, Ohio, greater lifting power.

A mixture of ninety percent helium and ten percent hydrogen would not contain enough hydrogen to be inflammable, experts say. Such a mixture would enable the Navy's newest airship to lift about 4,600 pounds more weight than if filled with helium alone. This increased lift would enable the big dirigible to carry at least twenty-five additional persons, or 750 more gallons of gasoline.

There would be some extra difficulty in the periodic task of repurifying the airship's gas, but this would be largely offset by the fact that hydrogen is much less expensive than helium.

AUTOGIRO FLIES FROM ENGLAND TO FRANCE

A BRITISH aviator named Brie flew from England to France the other day in an autogiro, further demonstrating the reliability of such craft. After his arrival at Le Bourget Field, near Paris, the Britisher put his machine through its paces for the benefit of French aviation authorities, who had gathered for an air safety congress. The "flying windmills," described on page twenty-eight, are becoming more common on the world's airways. With their commercial production in this country, numbers of them may soon be seen at American aviation centers.

Dynamometer shows right-handed person's right hand is stronger than left.

What It Means to Be Left-Handed

By JOHN E. LODGE

ARE you right-handed? Perhaps you only think so. There is one chance in ten that you are ambidextrous, or "two-handed," without knowing it. If you are, you can learn to use your left hand as well as your right, and immeasurably increase your efficiency in work and sports.

Tests recently conducted by Dr. Thaddeus L. Bolton, head of the department of psychology in Temple University, Philadelphia, definitely confirmed earlier estimates that twenty percent of all people are ambidextrous. The experiments also brought out the striking fact that half of that number are unaware of it.

In other words, in every group of ten supposedly right-handed students Dr. Bolton subjected to the tests, there was one who, to his own surprise, proved to be ambidextrous. These cases the psychologist classes as instances of "suppressed left-handedness."

One of the tests is so simple that you easily can make it yourself. It is the wand-twirling test, designed to ascertain the learning capacity of the left hand. Both hands are given an equal amount of practice in twirling a light wooden wand, or stick, as a drum major twirls a baton.

If you believe yourself to be right-handed, begin by twirling the wand to the left in the fingers of the right hand. Do this for, say, three minutes and make careful note of the number of successful twirls you accomplish. Then do the same exercise, for the same length of time, with the left hand, twirling the stick to the right. Again, note the number of successful twirls. Repeat both exercises half a dozen times. The left hand will begin showing a lower average of successful twirls and remain lower throughout the test.

Now reverse the process. In the exercise with the right hand, twirl the wand to the right, and in that with the left hand, twirl it to the left. If you are decidedly right-handed, your right hand will surpass your left, as in the first test. But if yours is a case of suppressed left-handedness, your left soon will outstrip the right, and keep its lead.

TO CHECK up on this experiment, Dr. Bolton, in his tests, inverted the order of the exercises. Taking a fresh subject, he had him do the second experiment first, and the first, second. In students with a tendency to left-handedness, the left hand showed supremacy from the start.

Three other tests preceded the wand twirling experiment. First, Dr. Bolton measured the strength of the two hands of each of his subjects with an instrument known as a dynamometer. On this apparatus the stronger hand registers the higher mark. Then he determined speed and coördinated motion with a tapping test in which the rate of tapping for a certain length of time by both the right and left hands was recorded.

The third experiment was designed to ascertain steadiness of motion. To do this, the psychologist used a device consisting of a number of parallel brass bars set at different distances from one another. The students were told to pass a stylus, held first in the right and then in the left hand, from left to right and from right to left, through the intervals or openings between the bars, and to try not to let the stylus vibrate either up or down and thus touch either bar. When vibration occurs, an electrical contact is made and a bell rings, the number of rings establishing the ratio of unsteadiness.

Hundreds of Temple University students, both men and women, were subjected to these tests. Sixty-five percent were shown to be definitely right-handed. Fifteen percent were decidedly left-

Dr. Thaddeus L. Bolton, of Temple University, Philadelphia, at work in his psychological laboratory, making tests to determine the ambidextrous ability of his students.

handed. The remaining twenty percent were ambidextrous, but only half of them knew it.

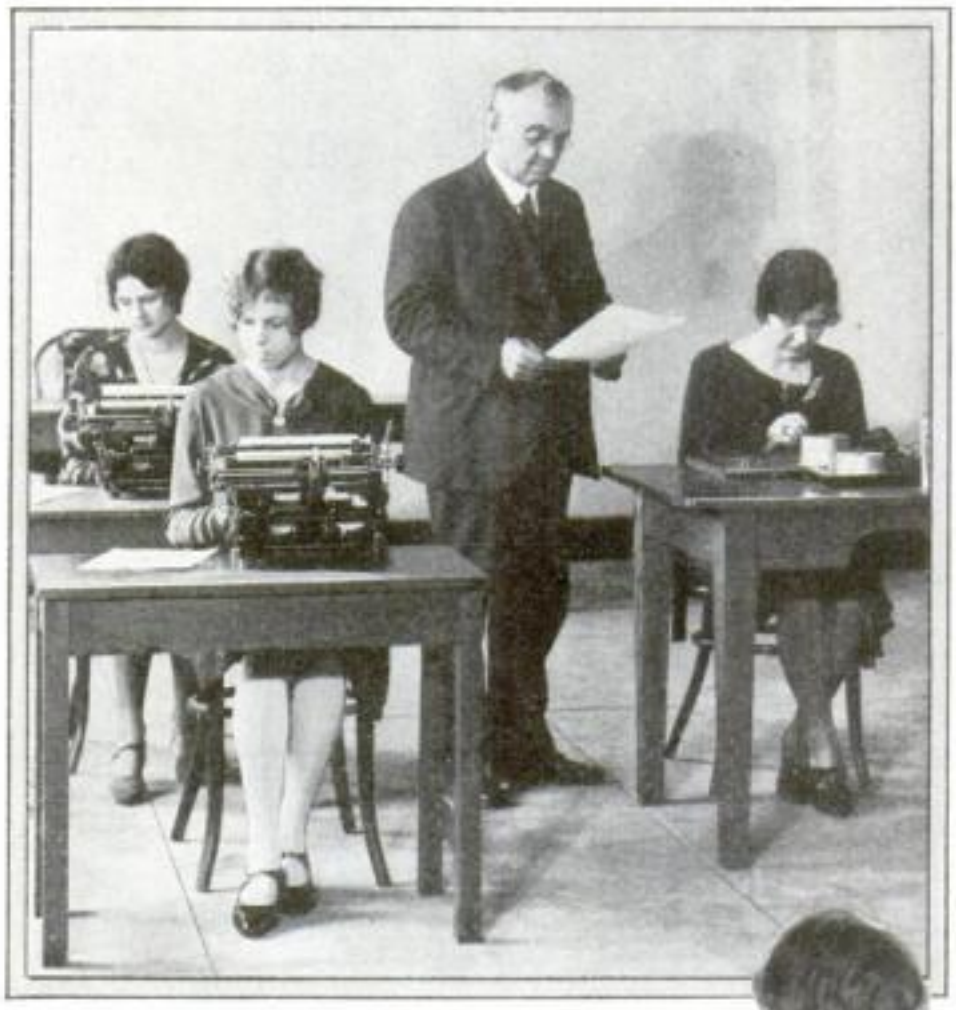
This ambidexterity varied in degree, for "two-handedness" does not always mean exact equality of both hands. If you perform most of your tasks with the right hand and yet possess a left hand of considerable skill, you are ambidextrous.

"The real value of this work," Dr. Bolton told me the other day, "lies in its possibilities when applied to children. All public school pupils after they have reached the sixth grade and begun to show occupational and professional preferences should be tested.

"The tests would prevent attempts to train young persons in specialized two-handed work if they are not suited to such tasks. Certain types of employment, such as typewriting, operating typesetting machines, and piano playing require a high degree of ambidexterity.

"My plan would be to test all children and only train those to be ambidextrous who use both hands with equal facility in the tests. To train those who are strongly and definitely right- or left-handed is inexpedient. Let them find occupations in which one-handedness is no handicap."

Dr. Bolton's theories differ sharply from those of Dr. P. Armaingaud, of the French Academy of Medicine, who, in a recent lecture before that body, suggested that children be trained to write with both hands. The habit of using only one hand, he declared, is ridiculous, needless, and obsolete, and any adult, with several months' practice, can make his left hand as useful as his right.



The purpose of this typewriter and three-hole test is to determine dexterity with both hands.

DR. BOLTON says it would be difficult to do this, as the relationship between the two hemispheres, or halves, of the brain and the two hands is hard to change. A right-handed person is left-brained, meaning that the left half of the brain leads in all action. A left-handed person is right-brained. This accounts for the circumstance that a right-handed person also is right-eyed, right-legged and right-footed; in fact, his entire right side is developed a little more strongly and is a little larger than his left side. In a left-handed person, the opposite is true.

When a right-handed person uses his left hand, he probably uses his left brain working through the right brain, instead of the right brain directly. But if he is to be made permanently left-handed, he also must be made right-brained.

In this connection, the psychologist told me that there is no direct relationship between "handedness" and intelligence. In other words, left-handedness in a child is no more a sign of backwardness than right-handedness is a symptom of brightness. The belief that there is such a connection is due to the fact that some backward and feeble-minded children happen to be left-handed.

THIS belief is chiefly responsible for the widespread prejudice against left-handedness, which has survived even among educated people. Dr. Bolton told me he receives a surprisingly large number of letters from teachers in various parts of the country, complaining that they lack the authority to "break pupils of left-handedness.

"They write me that the parents don't seem to care much," said Dr. Bolton, "and I tell them the parents are right. There is little occasion for changing left-handed people to right-handed people. Left-handed writing is just as fast as right-handed, and in almost all instances it is just as easy to read.

"As a matter of fact, left-handedness even has some advantages, particularly in sports. As everyone knows, a good 'southpaw' pitcher in baseball is invaluable because he confuses the opposing batter. Many of our greatest diamond stars were and are left-handed. Babe Ruth is the greatest left-handed slugger of all time and once was a brilliant southpaw pitcher. 'Lefty' Grove of the Philadelphia Athletics and Pipgras of the New York Yankees are other examples. In football, too, some advantage is gained by a team that has a man playing a left-handed tackle or a left-handed guard to the confusion of the opposing eleven.

"Most left-handed children feel superior to their playmates. The reason is that they can do something—for example, writing with the left hand—that the others can't. They have a specialty. This tends to make them independent and self-reliant.

"For these reasons I deem it inadvisable to 'break' a child of left-handedness. But developing the other hand and thus encouraging ambidexterity is an entirely different matter. Here the transfer is not as severe and consequently not as difficult."

Persons who generally use the right hand but prefer to perform certain tasks such as, for instance, handling the cue in billiards, with the left, are cases of suppressed left-handedness, according to Dr. Bolton. Such people, he says, can train themselves to be ambidextrous without undue effort.

What produces left-handedness? The primary cause of left-handedness is the tendency of our brains and bodies to depart from a strict symmetry, or balance. This lack of symmetry manifests itself in a larger brain hemisphere on the left accompanied by a slightly larger body development on the right side, or in a larger brain hemisphere on the right with a slightly larger body on the left.

THAT these differences exist has been established by careful measurements of left-handed and right-handed persons. But the matter still is very much in the guessing stage. Some weeks ago, two investigators of the University of Chicago, Loh Seng Tsai and Siegfried Maurer, succeeded in making a number of right-handed white rats left-handed by feeding them a diet lacking in vitamin B.

Endurance and coördinated motion were tested by tapping, number of taps a minute being electrically recorded.

In these experiments, the rats, after having been deprived of vitamin B for a certain period, were fed from long-necked bottles. Rats, it appears, eat with one paw. Those formerly right-handed stuck their left paws into the bottle necks.

One hundred male and one hundred female rats were used in the tests. Of the males, sixty-nine were right-handed and thirty-one left-handed before vitamin B was denied them. Afterward, exactly half were left-handed. Of the females, fifty-four were right-handed and forty-six left-handed, and the left-handed group was increased by three as a result of the test.

Cruising through the traffic of New York City, Schalkham studies list and watches for lost autos.

Patrolman August Schalkham of New York has trained himself to remember police records and recovered 183 cars in two years.

Cop's Memory Recovers Stolen Autos

By CLAYTON R. SLAWTER

TO ONE man in New York City, the ceaseless stream of traffic that roars through avenues and streets is a perpetual procession of numbers. Flitting in and out of the bewildering maze in his police automobile, Patrolman August Schalkham does not see the trucks, roadsters, touring cars, and limousines that surround him. He cares little about the shape and make of the machines, nor about their drivers and occupants. For him the unending pageant resolves itself into a passing show of license plates, the numbers on which he constantly compares with those on a list of more than 1,000 stolen cars. And that long list Schalkham carries—in his head.

Entirely on his own initiative, this terror of automobile thieves has developed his memory to the amazing point where, thus far, it has enabled him to pick 183 stolen cars out of the welter of vehicles that chokes the streets of New York. In his capacity of "number hunter" he has become so valuable to the force that he has been taken off fixed post and given a police car and a roving assignment to cruise where he will in pursuit of stolen machines, or "hot" cars, as the members of the city's underworld call them.

The other day, I sought Schalkham, "Eagle-Eyed Gus" to his brother policemen, to find out how he made himself into a one-man bureau for the recovery of stolen automobiles. I met a big, burly, good-natured cop, just as modest about his remarkable feats of memory as he is about the ribbons of three citations for bravery that adorn his police tunic just above his badge.

"IT'S my hobby," he told me. "Some people collect postage stamps, or oil paintings, or diamond necklaces. Others 'collect' cars that don't belong to them. I get a lot of fun out of memorizing numbers.

"It started when I was a kid. My brother and I used to play a 'number game' with passing freight cars in the railroad yards near where we lived. We would look hard at the numbers one day and then try to spot the same cars when they passed again days afterward.

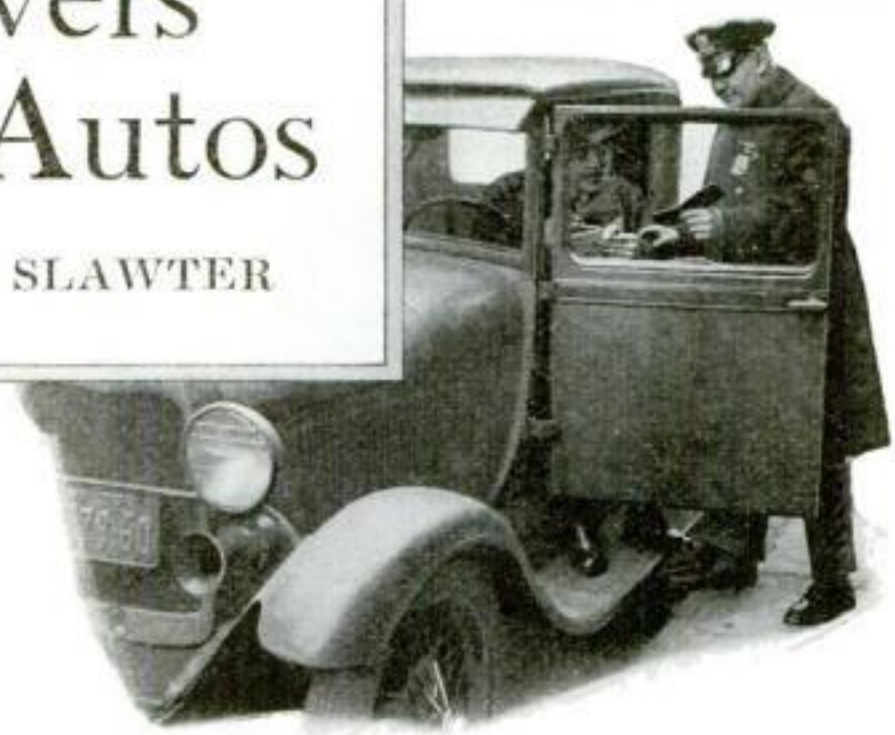
"I hadn't thought much about this old stunt until two years ago, when I was put on traffic duty on Manhattan Bridge. It was a slow job, so, to keep my mind occupied, I kept a notebook. I wrote down the numbers of stolen cars broadcast by headquarters in regular numerical order, and then compared them with the licenses of the cars driving across the bridge. I started with about twenty-five numbers. Because I looked so often in the book, the numbers just naturally stuck in my mind. Pretty soon, I didn't need the book at all, and I began to play the old 'number game' all by myself. After a while, I could remember hundreds of them. It's all a matter of practice, I guess."

In addition to his ability to memorize numbers, Schalkham has developed the faculty of reading licenses on every car in the thickest traffic. The faster they come, the better he likes it.

"WHEN you come right down to it," he explained, "it's the same system they use in the grade schools. The children learn their A B C's from looking at blocks, and cards, and pictures. Well, it's the same thing with license numbers. If you look hard enough at a thing, it will stick in your mind."

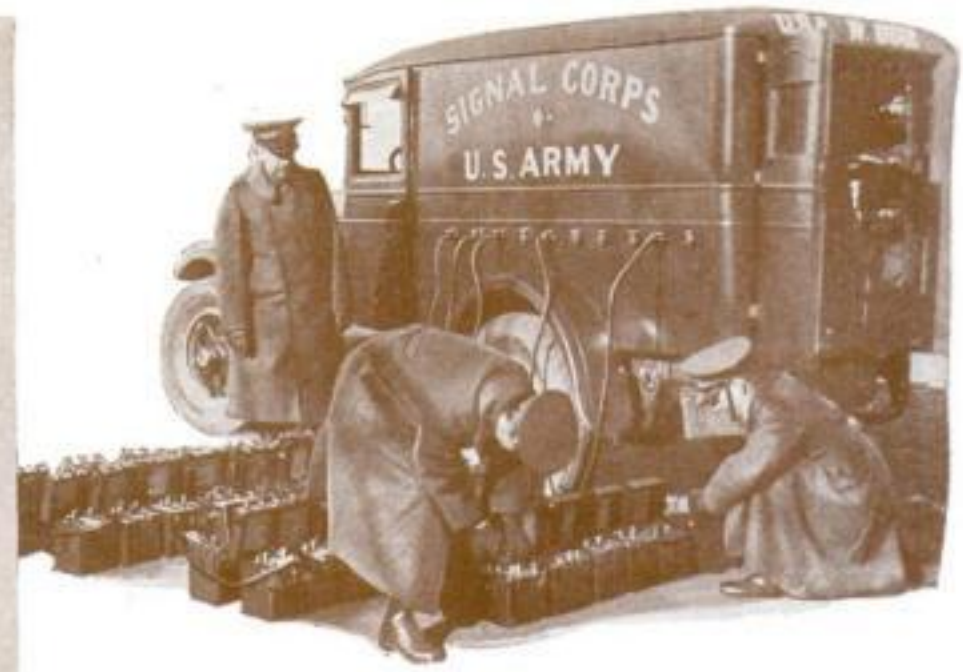
In this way, Gus has developed his memory until it now is as sensitive and retentive as a photographic plate. Naturally, his ability to remember faces and names has kept step with his uncanny faculty for remembering numbers. But he does not rely entirely on his unusual mental prowess when making arrests. He always carries with him a small card index, and the number on a wanted car is checked from this before he goes after its driver. The index is simple. Serial numbers and letters of licenses are arranged in numerical and alphabetical order in the left-hand column of a card, for example, 1-A, 2-A, and 1-B, 2-B. Remaining figures of licenses of stolen cars in that series are listed to the right, also in numerical order.

As for the ribbons on his uniform, one was received from the U. S. Army while fighting in France during the World War. The other two were for police work.



Eagle-Eyed Gus, before making an arrest, always confirms his memory with pocket list.

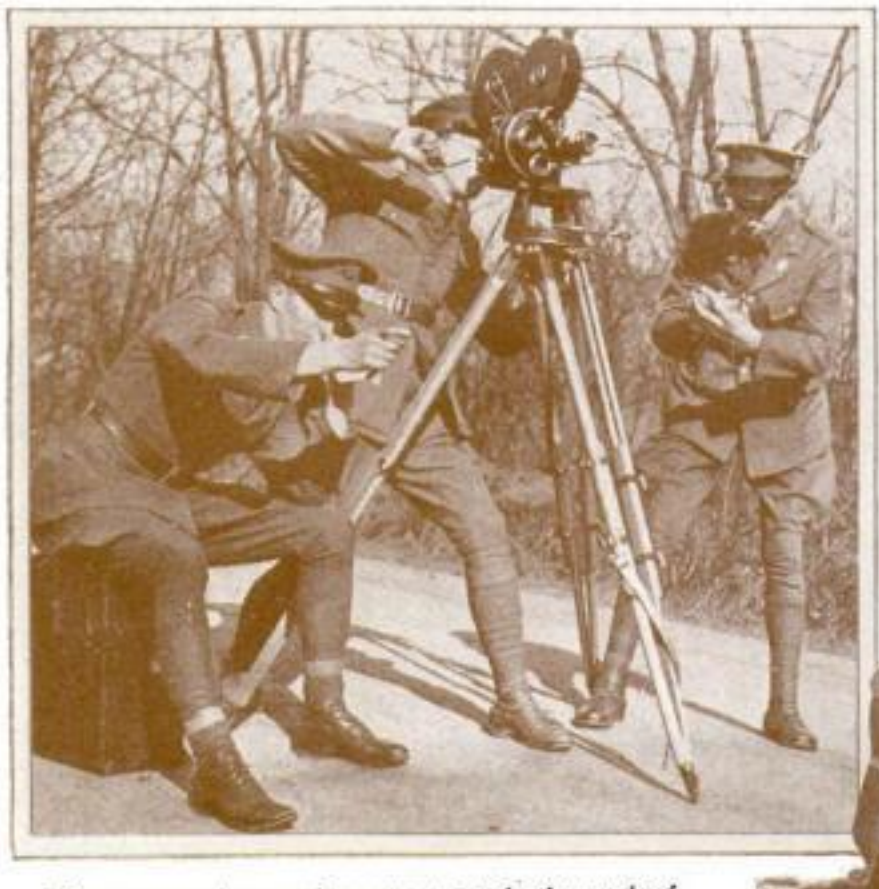
How U.S. Army Trains Its Signal Experts



Electric batteries, extensively used by the Signal Corps, are likely to go dead and this portable charging unit then is called.

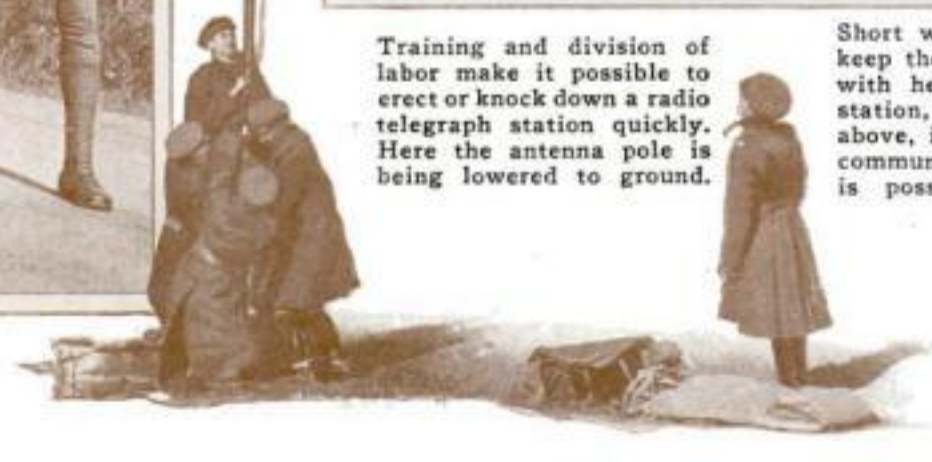
All branches of military communication are taught to enlisted men at the Army Signal School, Fort Monmouth, N. J. The man above, in the meteorological unit, is fixing a wind gage.

Radio and telegraph are united for distant communication, and messages are sent and received from a field station like this.



The camera plays an important part in the work of the Corps and thorough instruction in using the motion picture machine is given members of the photographic class, three of which are shown above.

Short wave loop radio sets keep the front line in touch with headquarters. A field station, like the one seen above, is set up and instant communication with the rear is possible at all times.

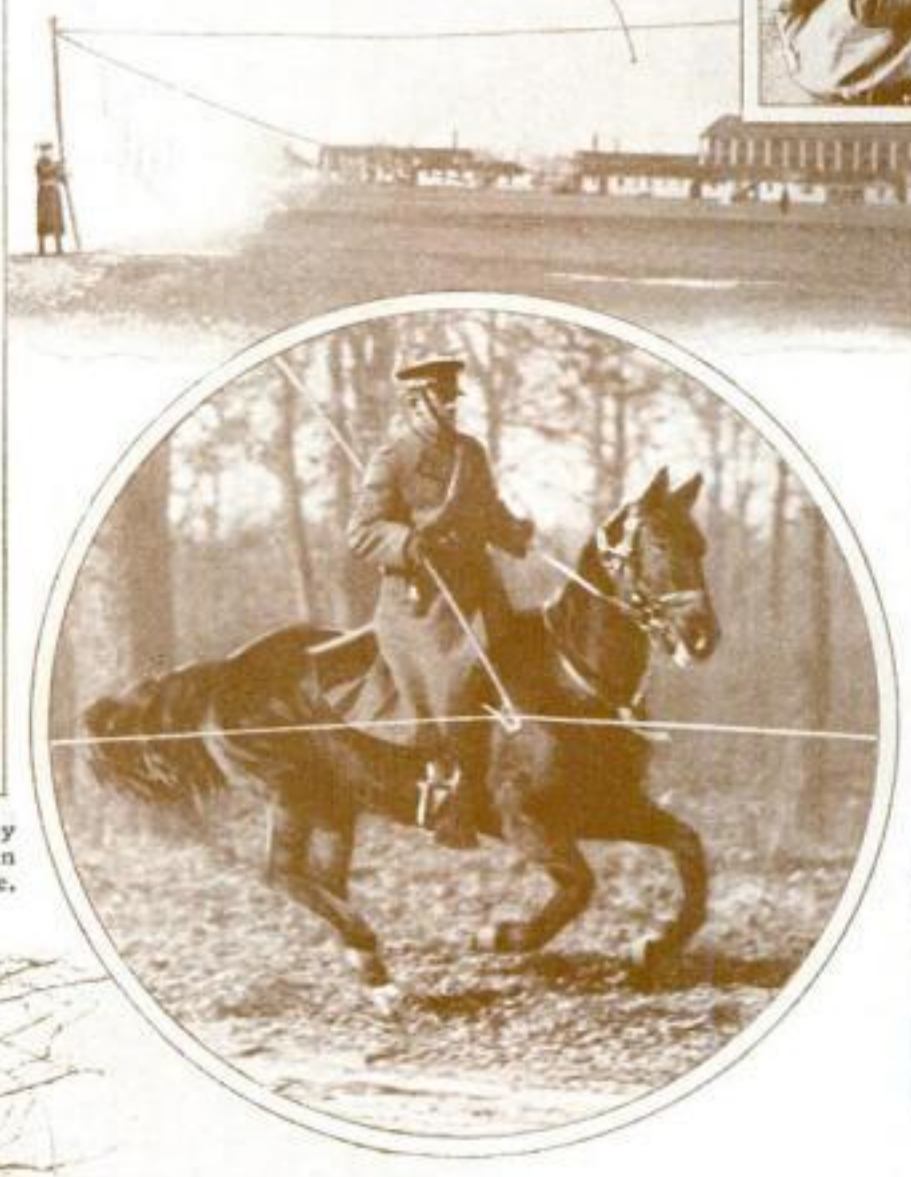


Training and division of labor make it possible to erect or knock down a radio telegraph station quickly. Here the antenna pole is being lowered to ground.

Messages and maps can now be picked up by planes in flight. The message is attached to a horizontally strung wire, right, and the plane, flying low, drops a grappling hook and zooms up with both the wire and message.

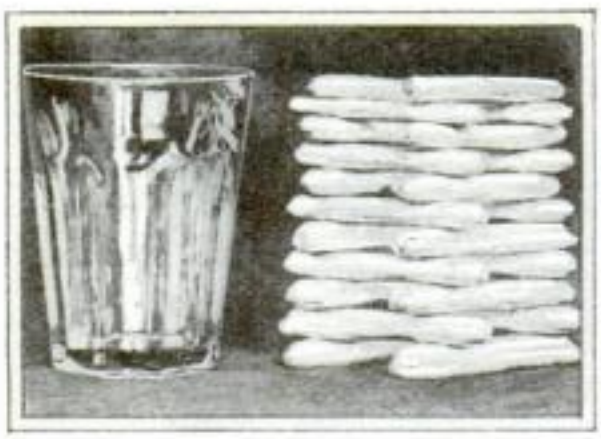
Is the circuit still open? It is the business of these test points to find breaks in the wire while fight is on.

The message to be picked up by the flying plane is put in an envelope and fastened to the wire.



Pole climbing is part of the work required of the electricians' class. They must run up poles and put a cross arm in place.

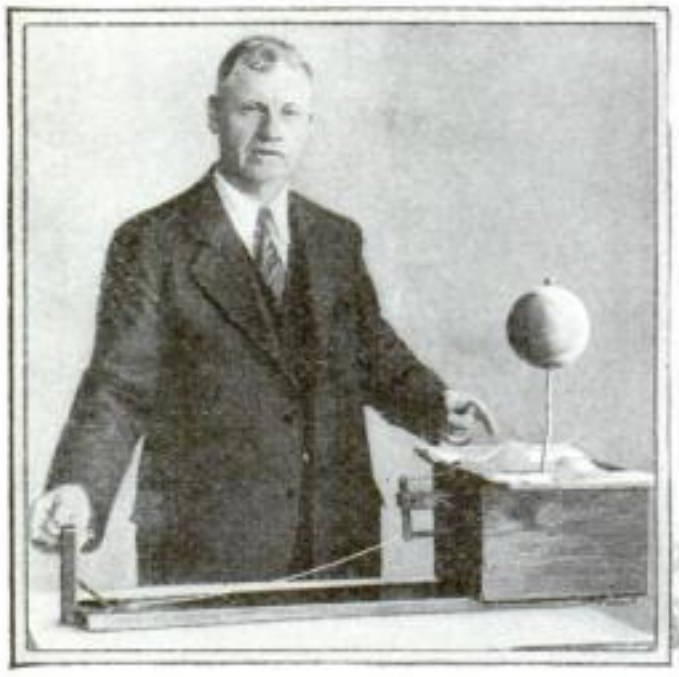
Telephone and telegraph need wire, and the laying of this is an important job. In the circle, the pike man keeps the wire out of the way of Army traffic. At left, connecting the Command Post Truck with telephone units farther out in the field. Above, horse unit, which rapidly lays or picks up the wire, using a reel cart.



INDIUM WORTH $17,000; WHAT'S IT GOOD FOR?

HAVE you ever heard of "indium"? Here is what $17,000 worth of it looks like, posed beside an ordinary drinking glass for comparison. A pound of gold would buy scarcely enough of this white, lustrous metal to make a good sized bracelet.

A few months ago, a Cleveland, O., chemical firm announced proudly that it had prepared more than a pound of pure indium. Its rarity alone is responsible for its costliness, since no one has yet discovered a vital use for it. Recently, however, experiments have shown it can be used in alloys of which high-temperature thermometers are made. Its compounds may prove to be drugs having valuable new medicinal properties. One of these days, some experimenter may make a name for himself by discovering a use for indium.



TINY BALLOON SERVES AS PLANE'S S O S

AIRPLANES in distress could fly their own SOS signals, through a device recently developed by T. H. Furman, of Rialto, Calif. His invention is a small box with a spring lid, containing a small captive balloon, carried near the tail of the fuselage. If forced to land, a pilot would release the brilliantly-colored gas balloon, which, rising to the end of its tether of light wire, would guide rescue pilots.

SKYSCRAPERS DIE AT 30

THOUGH modern skyscrapers look as if they would last for ages, their actual life seldom exceeds thirty years. The National Association of Building Owners and Managers says that tall buildings do not wear out, but are torn down to make way for more modern structures.

GERMAN PUPILS TAUGHT WITH SHIP MODELS

SHIPBUILDING is taught to boys in a Potsdam, Germany, school by the use of ship models.

The school has a complete line of miniature ships, ranging from fifteenth century sailing craft to the largest battle cruisers used by the imperial German navy during the war.

These little craft can be taken apart for study purposes so the students may familiarize themselves with the many types of ships that have been built in their country during past centuries. This method of teaching the art of naval architecture is said to give young ship designers a knowledge of the history of the profession as well as the practice of it.

Models of all types of ships built by Germany during past centuries are used in school to teach students shipbuilding art.

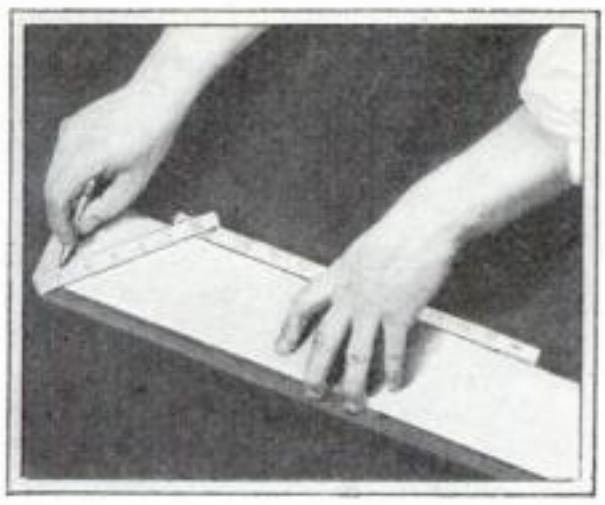
Left, above, signal balloon rising from box. Above, the balloon over a wrecked plane.

NEW STEP IN CONQUEST OF PERNICIOUS ANEMIA

NEWS of another advance in the battle against the dread scourge of pernicious anemia follows the recent presentation of POPULAR SCIENCE MONTHLY'S $10,000 annual award in science to Drs. George H. Whipple and George R. Minot, pioneers in the malady's conquest.

These two men discovered that a diet of liver would cure sufferers from the disease, for which no cure had been known. The liver diet proved a quick and powerful factor in the production of red blood cells. So that patients need not eat the half pound of liver daily that this diet would require, the discoverers also succeeded in separating a "liver fraction" containing the chemical that is of benefit. As a result physicians have prescribed it, during the last year, in powder form.

Now a new step in concentrating the chemical has been accomplished by three investigators at the Columbia University College of Physicians and Surgeons and Presbyterian Hospital—Drs. R. West and H. D. Dakin, and Marion Howe. They have isolated from liver the undiluted antianemia chemical. If it can be made synthetically, it raises the hope that a cheap anemia remedy may be had.



NEW TOOL COMBINES MITER AND RULE

A COMBINED miter and folding rule, handy for carpenters and cabinetmakers, has been developed by a New York firm of tool manufacturers. The device can be set to register angles as well as measure distances in feet and inches.

Lock joints between its sections can be set rigidly at forty-five or ninety degrees when marking bevels or angular cuts. Use of this instrument eliminates the necessity for miter boxes on many small jobs.

MACHINES TO PREPARE, COOK, AND SERVE FOOD

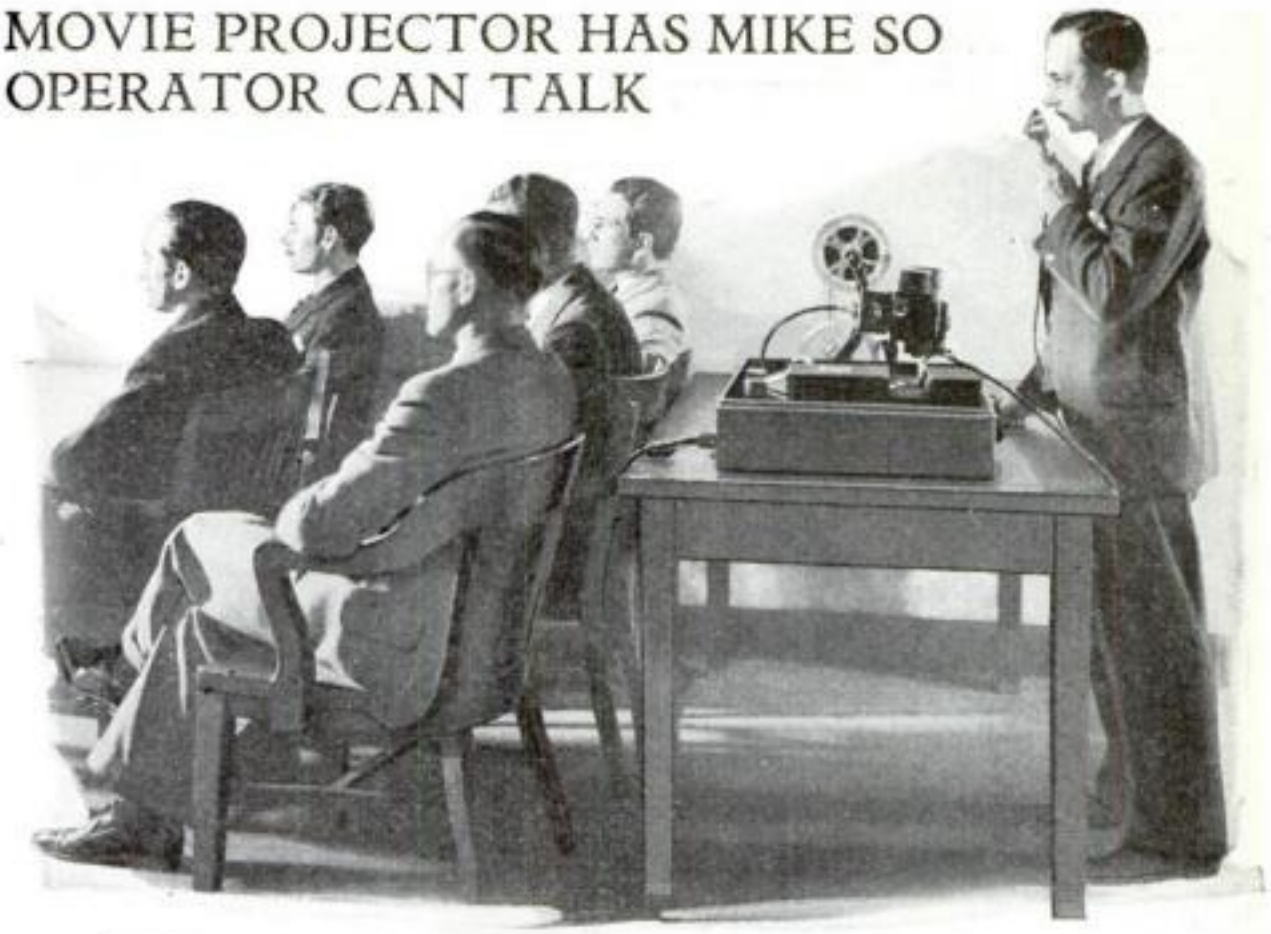
AUTOMATIC machines will place food before a diner, and whisk his empty dishes away to be washed, in a New York restaurant planned by H. Russell Brand, New York City inventor. No human hand will touch the dishes.

Recently in his laboratory, Brand exhibited one of his inventions for the restaurant, illustrated above—an automatic wheat cake cooker and server. When a demonstrator inserted a slug supplied by a "cashier," the grill started working, and placed the finished wheat cakes on a plate which a moving belt deposited, through a door, before a person representing a diner. When the "diner" arose, the tray was carried off to be washed automatically.

AIR IGNITES THIS PASTE

A GERMAN firm announces the perfection of a "fire paste," in semisolid form, put up in a container resembling a toothpaste tube. When the tube is squeezed, the paste liquefies and as a drop of the clear liquid falls it takes fire in the air. Caught in a suitable receptacle it can be used to light cigarettes or start a fire.

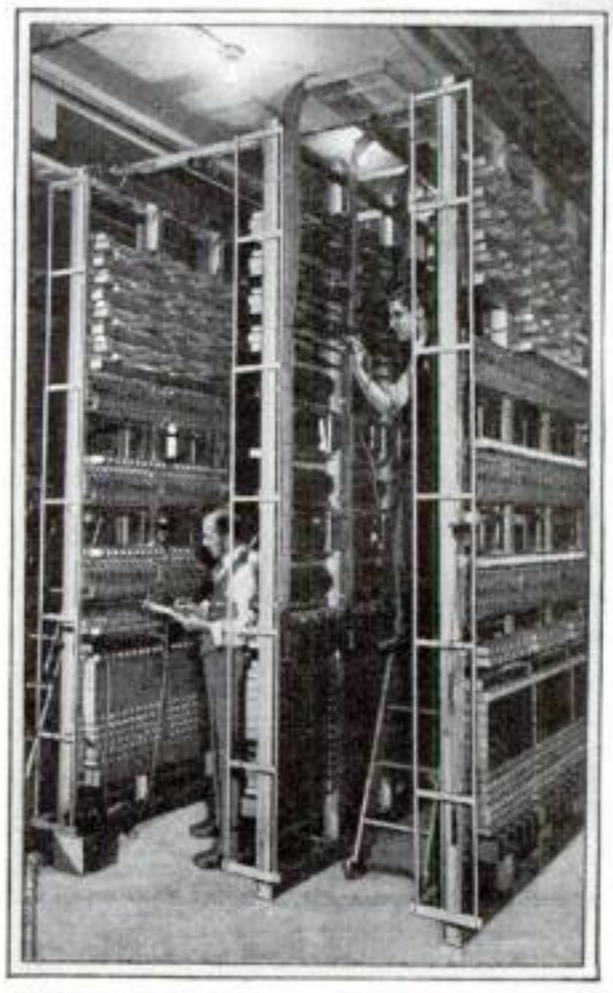
MOVIE PROJECTOR HAS MIKE SO OPERATOR CAN TALK



Attached to this portable movie projector is a microphone that enables the operator to cut in and explain the silent pictures or cut out sound and give his own explanation.

A PORTABLE motion picture projector recently perfected in Chicago, Ill., has a microphone attachment that permits the operator to talk while silent movies are being shown, or add his own remarks to those of the talking pictures. Home movie film is used in the projector. A phonograph supplies sound for the talkies. When the operator "plugs in" to talk the sound record is automatically shut off.

The apparatus is packed for transportation in two cases. One contains the phonograph with amplifier and accessories. The second carries the loudspeaker, projector, three reels of film, and connecting cords for assembling the device.



This super-robot, only one of its kind, distributes incoming messages in record time.

SUPER-ROBOT SPEEDS PHONED TELEGRAMS

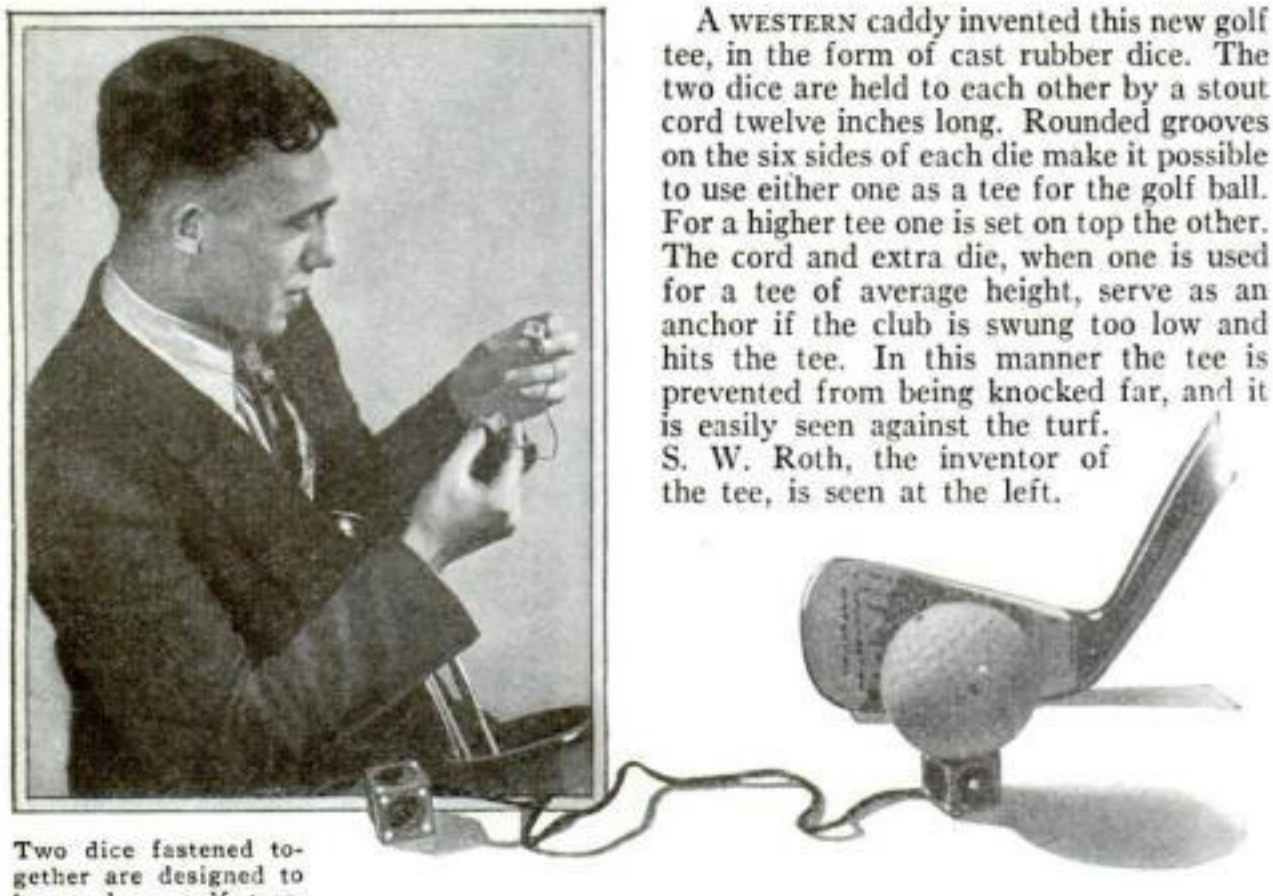
WHEN a New Yorker calls one of the city's principal telegraph companies on the phone to send a wire, he now sets in motion a super-robot so swift that a stopwatch often cannot time it.

Within the short space of one second, on the average, he hears the answering voice of one of 110 girls, who sit at desks as shown in photo above. This is made possible by the "automatic call distributor," called one of the most important inventions in recent years.

This intricate machine, a maze of contacts and wires twice as tall as a man, instantly detects an incoming call, hunts for and finds an unoccupied typist, plugs in a connection to her desk, and signals that there is a message for her to take. If she fails to respond, the robot switches the call to another typist.

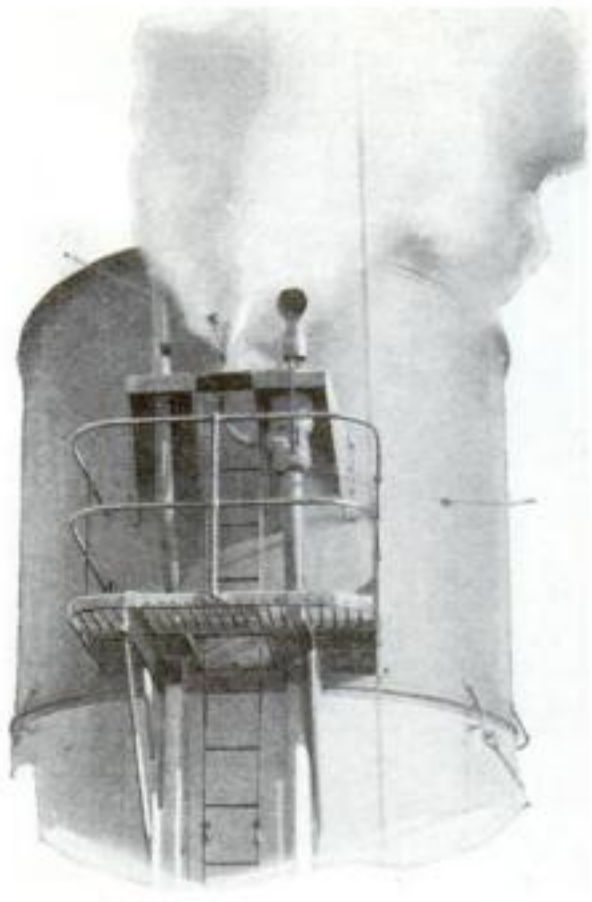
Similar "robots" are planned for Chicago and Boston, according to Western Union officials who installed the first one.

DICE STRUNG TOGETHER NEW GOLF TEE



Two dice fastened together are designed to be used as golf tees.

A WESTERN caddy invented this new golf tee, in the form of cast rubber dice. The two dice are held to each other by a stout cord twelve inches long. Rounded grooves on the six sides of each die make it possible to use either one as a tee for the golf ball. For a higher tee one is set on top the other. The cord and extra die, when one is used for a tee of average height, serve as an anchor if the club is swung too low and hits the tee. In this manner the tee is prevented from being knocked far, and it is easily seen against the turf. S. W. Roth, the inventor of the tee, is seen at the left.



WHISTLE FINDS SHIP'S DISTANCE FROM SHORE

BLOWING a special whistle recently installed on the *Prince Robert*, her captain can find out how far he is from cliffs in thick weather by noting the time required for the echo to return. If ten seconds elapse before the echo is heard, he knows that he is about one mile offshore. The shrill, dry-toned whistle helps to navigate difficult passages between islands and mainland off British Columbia. At its left, in the photograph, is a common whistle, and at right the usual siren.

MOVING LAMP SHADE SERVES AS CLOCK

A CLOCK and an electric lamp are combined in a novelty recently placed on the market in New York City. A tiny electric motor mounted in the center column rotates the lamp shade, the lower edge of which is divided into hours and minutes, past a fixed pointer. An automatic clutch permits the shade to be removed, stopping the motor. It also allows the shade to be revolved by hand when setting the "clock."

Since the driving motor is wired independently of the lighting circuit, the clock runs whether the lamp is turned on or not. The motor is noiseless in operation and the shade moves so slowly that its motion is hardly visible. The shade makes one revolution in twelve hours, giving the effect of clock dial moving past the hour hand.

A motor in the lamp standard turns the shade slowly so that it serves as a clock, which, independently wired to a noiseless motor runs even when light is turned off.

CITY FOLKS OUTNUMBER COUNTRY PEOPLE

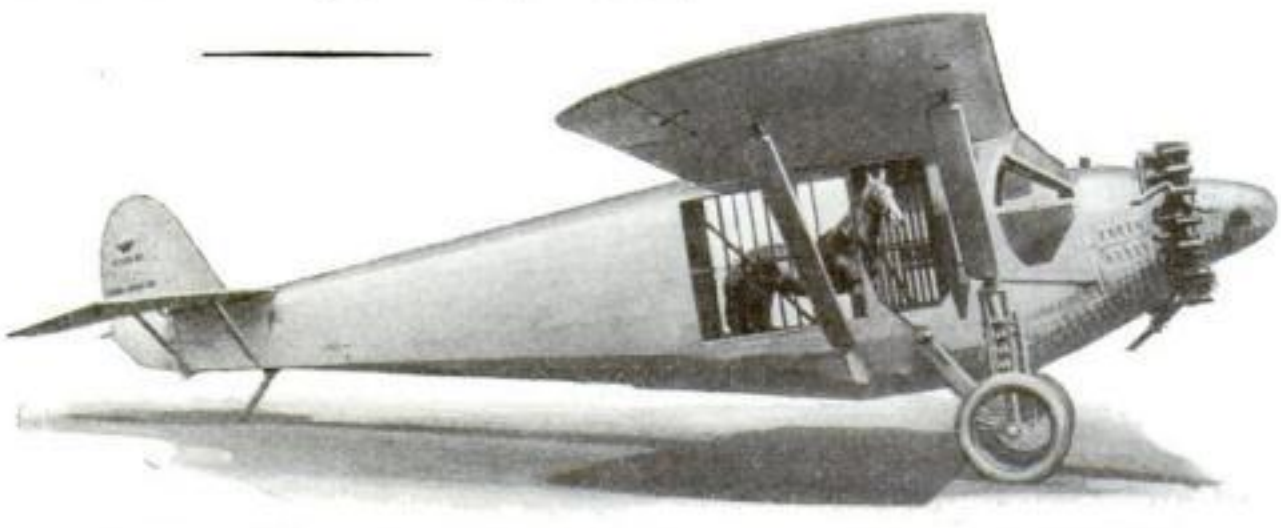
CITY dwellers in the United States, according to a recent announcement of the Census Bureau, outnumber country people. Fifty-six out of every one hundred people in America make their homes in urban districts. This represents an increase over the figures for 1920, when the city dwellers were in the majority by the narrow margin of fifty-one of every one hundred of population. Places with a population of more than 2,500 were included in the "city" class.

FLYING STABLE CARRIES RACE HORSE TO TRACK

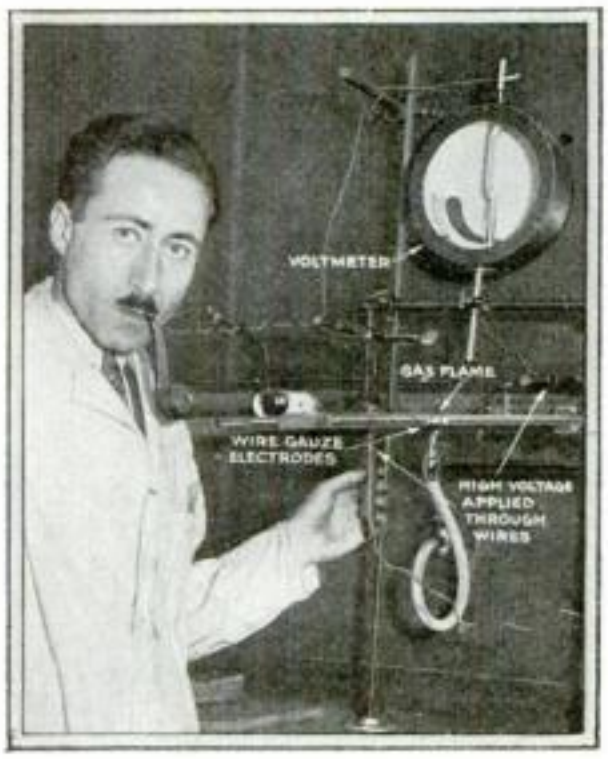
THE latest development in luxurious transportation for thoroughbred race horses is a flying stable recently built by a California airplane manufacturer.

All fittings were removed from the cabin of an inclosed monoplane and large windows were cut into its side walls. Stout bars were placed across them so the animal could not hurt himself by breaking through them if he took fright while in the plane.

A Western trainer used this unusual machine recently to transport a horse to a Mexican race track. He said the animal arrived in good condition and he suggests that in the future planes will be generally used to transport horses.



In this specially constructed cabin airplane horses are carried swiftly from track to track and after a long journey through the sky they are unloaded in perfect condition.



HIGH VOLTAGE CURRENT EXTINGUISHES FLAME

FIRE in a mine is always a deadly peril. Explosions and cave-ins may block the work of fire-fighting brigades equipped with ordinary apparatus. Therefore mine officials watched with unusual interest the experiments of Bernard Lewis, physical chemist at the Pittsburgh, Pa., station of the U. S. Bureau of Mines, who recently demonstrated that he could put out a flame with electricity.

Lewis lit a gas flame in a glass tube. Then he brought near it, from each side, a piece of wire gauze charged with high voltage electricity. The flame vibrated convulsively, dwindled, and went out. Burning carbon monoxide gas, and gaseous carbon-and-hydrogen compounds like the dreaded "fire damp" of miners, were successfully extinguished.

The electrically-charged pieces of gauze, Lewis told POPULAR SCIENCE MONTHLY, literally tear the flame to pieces. When an inflammable gas burns, the hot flame throws off particles of negative electricity, leaving the products of combustion charged with positive electricity. His high voltage electric field draws negatively charged electrons to one electrode and positively charged particles to the other, breaking up the flame. Whether the same thing may be done outside the laboratory, and if so on how large a scale, remains to be seen.

FIRST CAR TO TRAVEL CANADIAN WILDERNESS

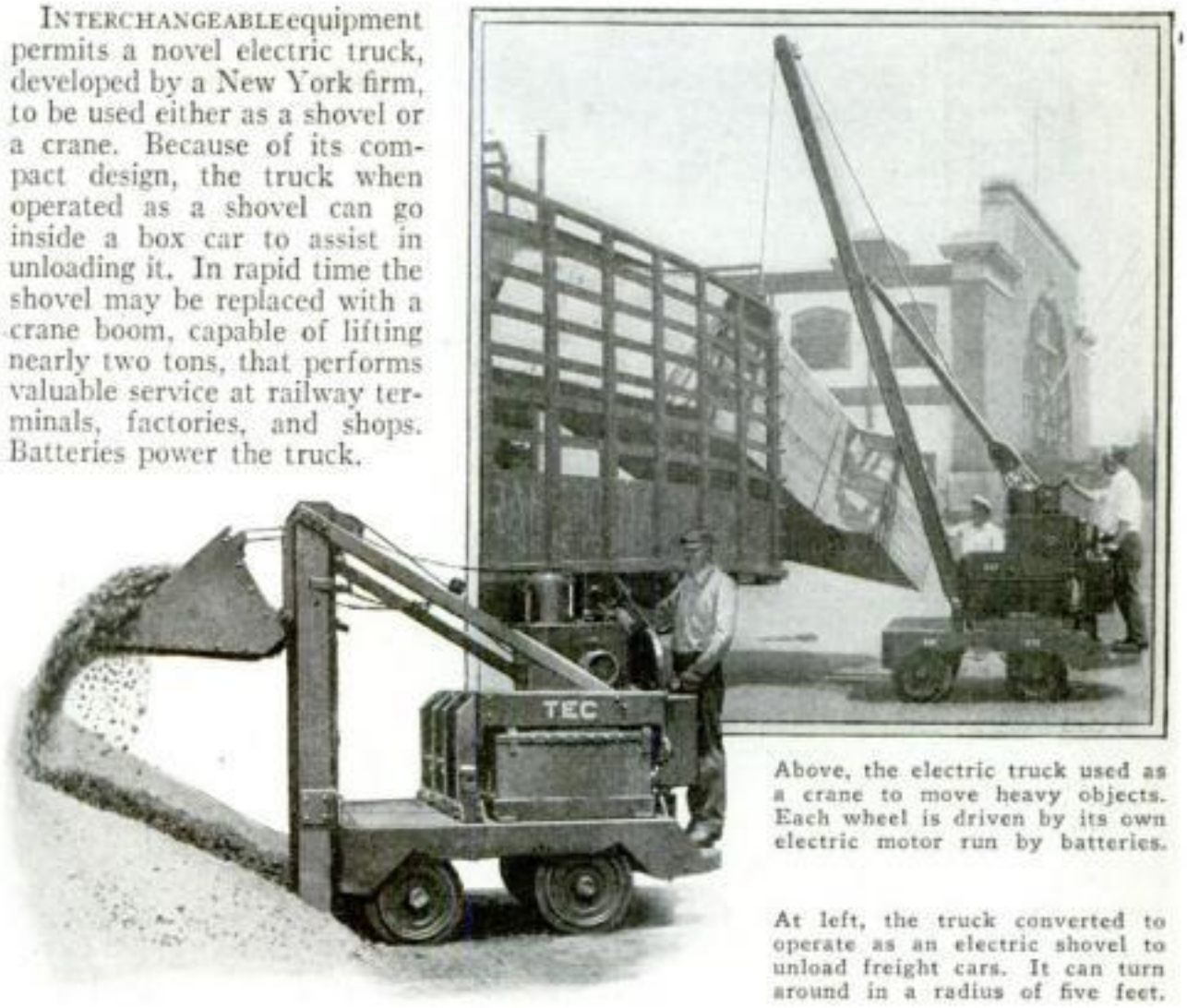
FIRST to cross Canada by motor, from coast to coast, is the ambition of Healy Needham, of Toronto. Recently, he fitted his eight-cylinder roadster with an iron bar, in place of a bumper, and started out from Halifax, in Nova Scotia, with a northern bushman for company. His announced destination was Vancouver.

Needham's attempt recalls pioneer motoring days in the United States, where today's transcontinental highways have made such a trip easy.

The trail blazers keep in touch with civilization by radio. At first they made about a mile a day in the Ontario wilderness, cutting young tamaracks and laying half a mile of board road at a time. With frozen ground, the traveling is easier.

NEW TRUCK WORKS AS SHOVEL OR CRANE

INTERCHANGEABLE equipment permits a novel electric truck, developed by a New York firm, to be used either as a shovel or a crane. Because of its compact design, the truck when operated as a shovel can go inside a box car to assist in unloading it. In rapid time the shovel may be replaced with a crane boom, capable of lifting nearly two tons, that performs valuable service at railway terminals, factories, and shops. Batteries power the truck.



Above, the electric truck used as a crane to move heavy objects. Each wheel is driven by its own electric motor run by batteries.

At left, the truck converted to operate as an electric shovel to unload freight cars. It can turn around in a radius of five feet.

HANDMADE BIBLE WEIGHS 1,094 POUNDS

Louis Waynai of Los Angeles, Calif., exhibits the Bible weighing 1,094 pounds which he made by hand.

A BIBLE too heavy to carry about is the work of Louis Waynai, of Los Angeles, Calif. It weighs 1,094 pounds, has 8,048 pages, and is bound in thirty-two detachable sections so it can easily be taken apart for transportation. Taking it apart or putting it together requires about half an hour's work. When opened, the volume is eight feet two inches in width, and when closed it is thirty-four inches thick. Waynai made the type himself and printed the book by hand, taking two years to complete the large Bible.

Blazing an auto trail through the wilderness of northern Ontario, Healy Needham, of Toronto, is determined to be the first man to cross Canada from coast to coast in a car.

At top, paint spray gun and in circle Berlin armored car that sprays water.

USE WATER AND PAINT TO QUELL BERLIN RIOTS

Police officers of Berlin, Germany, now have an armored car equipped with a harmless offensive weapon for dispersing mobs. A revolving turret at the top of its cab has a nozzle that discharges water at about 180 pounds pressure. Other nozzles at the sides of the machine spray water at about the same pressure. Police have found this pressure sufficient to knock people off their feet without injury.

Steel shutters completely inclose the truck's operators and prevent them from being injured by stones or bullets. A screen like a steel Venetian blind covers the windshield, protecting the driver.

Another method of scattering mobs recently devised by the Berlin police is a paint spray. A conical-shaped device resembling a fire extinguisher is filled with paint and squirted at random over a crowd of rioters. This breaks up the riot and also marks those in the mob.

MODEL BIGGEST LIZARD IN CELLULOSE ACETATE

Making museum models is the newest use for cellulose acetate, a substance used in "dopes" for airplane wings during the World War, and recently made available for commercial uses by a Wilmington, Del., firm. Recently experts of the Field Museum of Natural History used it to create an amazingly lifelike image of one of the giant lizards of Komodo, Dutch East Indies.

The huge lizards of Komodo were discovered in comparatively recent years on this tropic island, which the Dutch government has now made a game refuge to protect them. They are by far the largest living lizards in the world, and attain a maximum size of ten feet. Probably they are direct descendants of even greater reptiles, the dinosaurs of prehistoric times.

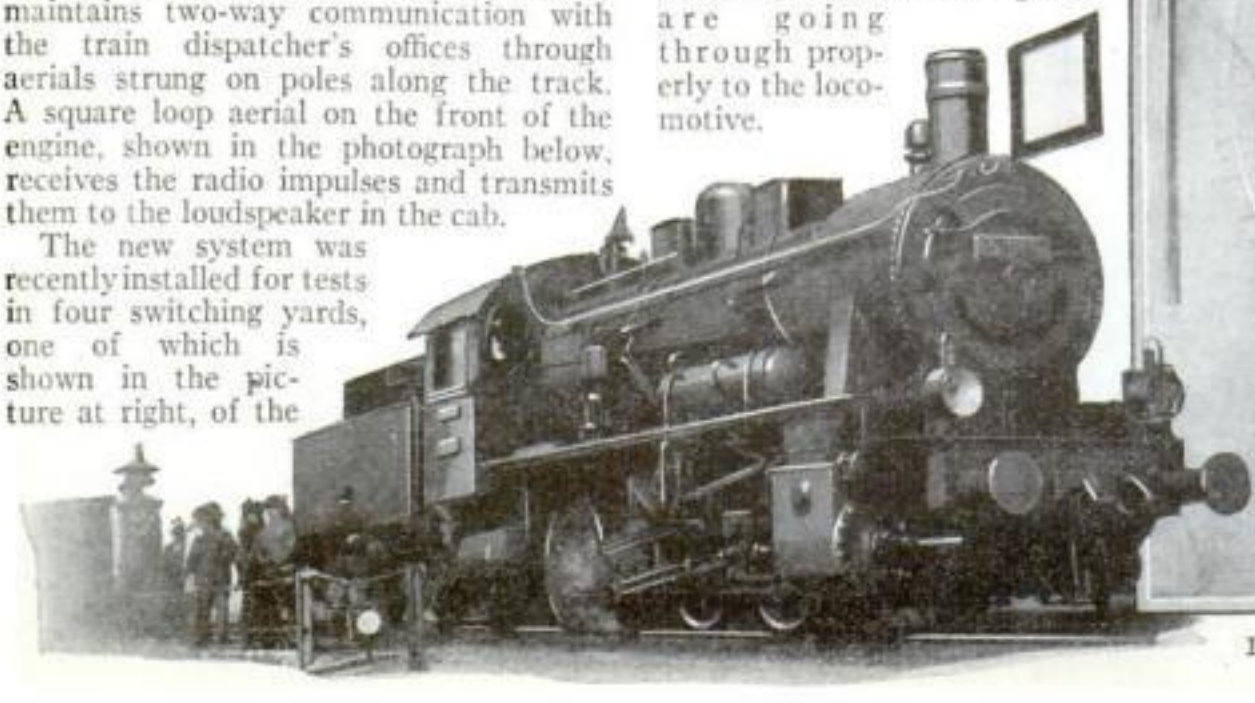
The specimen used in making the Field Museum exhibit was collected by the recent Chancellor-Stuart expedition to the South Pacific. The Komodo lizard, of which exaggerated reports had come from the natives, was first seen by white men in 1912. A meat-eating scavenger, efforts are now being made to prevent its extinction. It is closely allied to the monitor lizard of Australia and Africa.

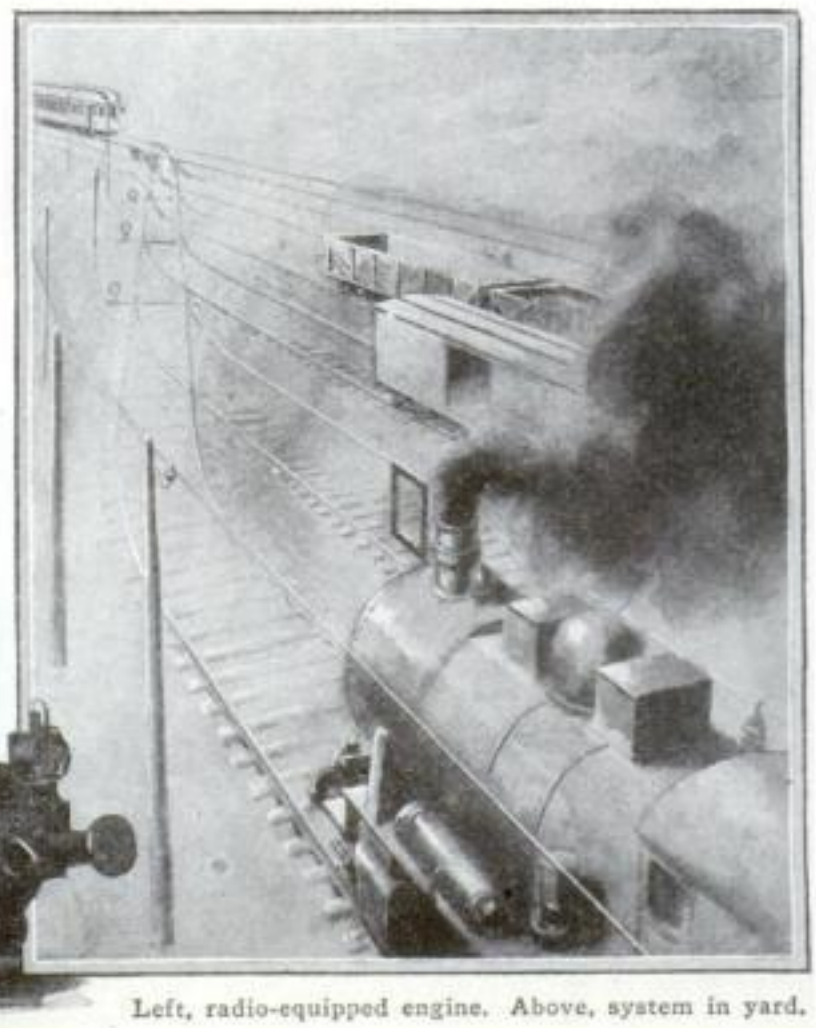
A ten-foot Komodo lizard modeled of cellulose acetate.

RADIO GUIDES ENGINEER IN FOG

Heavy fog, bugbear of railroad engineers, may be robbed of its terrors by a new radio signaling system developed in Germany. Dots and dashes in Morse code, buzzing from a loudspeaker in the engineer's cab, give him orders and enable him to proceed safely whether he can see the signals ahead or not. At all times he maintains two-way communication with the train dispatcher's offices through aerials strung on poles along the track. A square loop aerial on the front of the engine, shown in the photograph below, receives the radio impulses and transmits them to the loudspeaker in the cab.

The new system was recently installed for tests in four switching yards, one of which is shown in the picture at right, of the German State Railway. If successful, it may soon be applied on a larger scale. The apparatus may also be adapted to give signals by wireless telephone. A checking device tells, at any moment, whether the signals are going through properly to the locomotive.

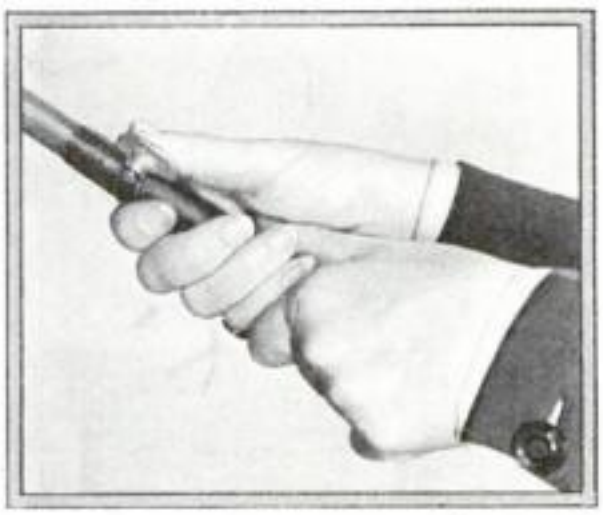




Left, radio-equipped engine. Above, system in yard.

THUMB REST INSURES RIGHT GOLF GRIP

A THUMB rest for golf clubs shows beginners at the game how to hold their clubs correctly during play. The little button-shaped device is secured to the club handle by a small screw and spring clip, making it adjustable to suit the individual user. By insuring correct position of the hands in gripping the club, it eliminates many missed shots and keeps the striking face of the club head in proper relation to the ball.



A rest for the thumb clips to a golf club and makes certain the beginner's grip is correct.

FILTER KEEPS PHONE NOISE FROM RADIO

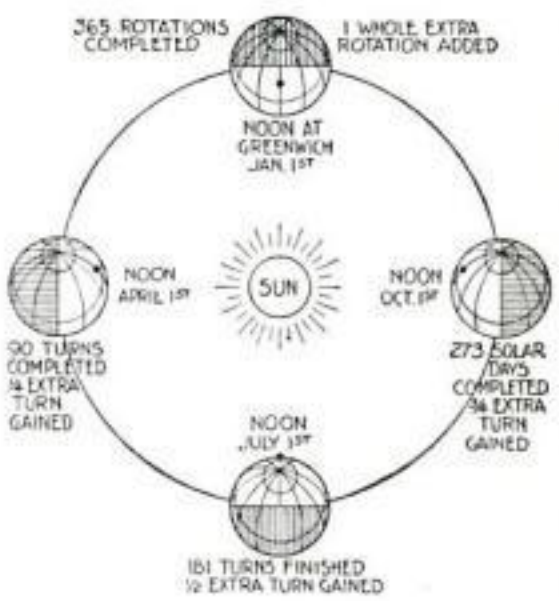
YOUR dial phone is a miniature broadcasting station, and the sparks it makes when a number is dialed may cause noises in near-by loudspeakers. Such interference is prevented by a small condenser that keeps telephone noises from radiating. It is easily installed in the base of the phone by changing a wire connection and removing a few screws. Its operation is entirely automatic and does not interfere with use of the phone in any way.

A condenser easily installed in base of your dial phone stops its interference with radio.

Harold Herbert, who with Dr. J. A. McReay, New York City, invented portable record maker, is seen above making a record and at right carrying the outfit.

Five Minutes of ASTRONOMY

EARTH ROTATES 366 TIMES IN 365 DAYS!



FOR convenience, let us begin the year as the astronomers do, at noon on January 1, when the sun is on the meridian at Greenwich, England. Our year will then consist of about 365 "solar" days, each of which is the interval between noon and noon at Greenwich. How then can an extra rotation of the earth on its axis slip in without being noticed?

During the three-month interval between noon on January 1 and noon on April 1, the earth has turned on its axis ninety rotations in all. Yet our diagram shows that at the completion of the ninetieth rotation, at noon on April 1, Greenwich itself has gained a quarter of a rotation! At Greenwich noon on July 1, the meridian of Greenwich is facing the opposite quarter of the heavens from that which it faced on January 1. The earth has now gained half a turn!

On October 1, the earth has added three fourths of another rotation. And at noon in Greenwich on the next January 1 (365 solar days from the year's start) the earth has made 366 complete rotations, but *without adding a day to the year!*

PHONOGRAPH RECORD MAKER IS PORTABLE

PACKED in a box that may be carried by hand like a suitcase, a new phonographic record maker and reproducing device can be taken anywhere for making records of a person's voice. The apparatus, perfected in New York City by Dr. J. A. McReay and Harold Herbert, consists of a phonograph turntable, amplifier, and electric pick-up device mounted in one case. Records made on it are square and said to be scratch-proof.

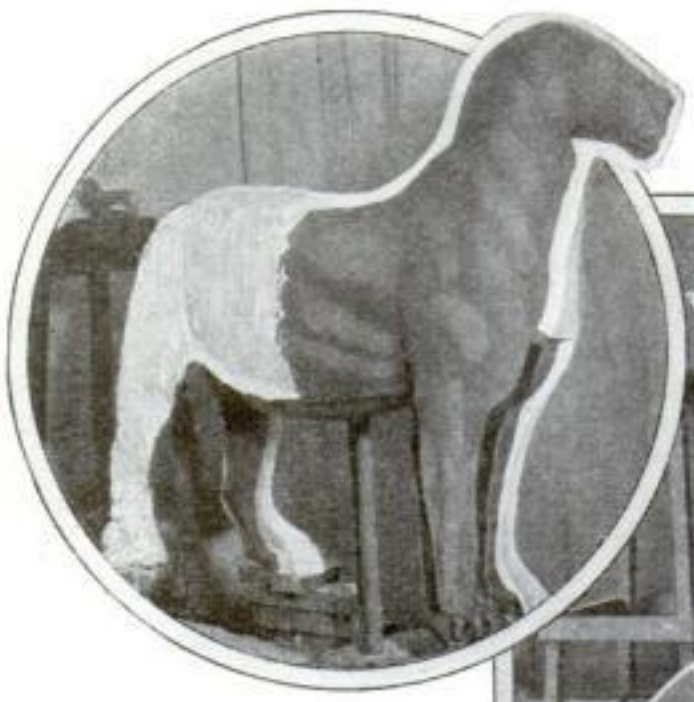
It has proved an advantage to clergymen and public speakers in preparing sermons and talks because it permits them to listen to their own speeches before making them in public.

WOULD GUARD AGAINST OPTICAL DELUSIONS

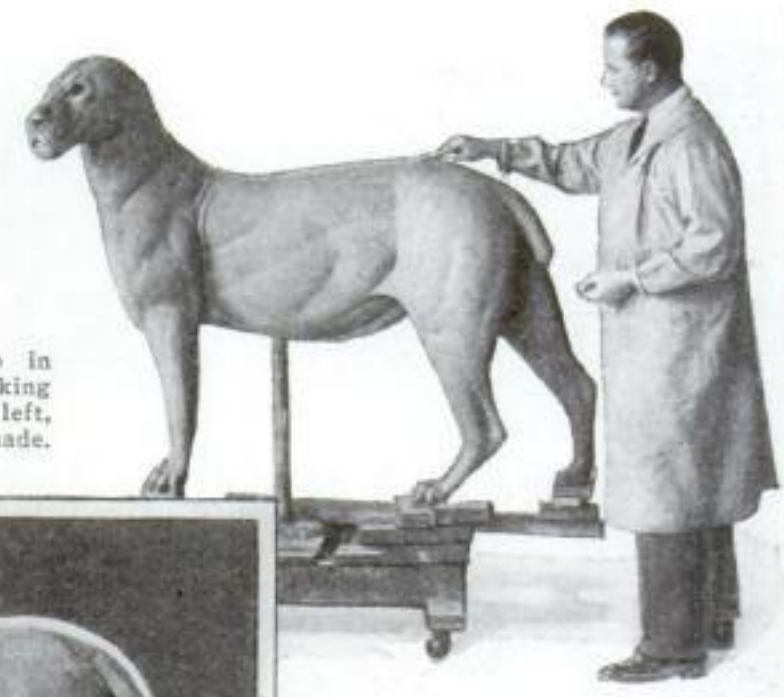
CONJURERS and stage magicians at every university to teach students how easy it is to fool the human senses are advocated by Prof. A. V. Hill, British biologist. By study and practice magicians can make audiences see things that are not visible and fail to see things that are. Similar pitfalls exist in scientific experiments, as well as in many affairs of ordinary life, the professor points out. Yet many business and scientific men continue to be fooled by the evidence of their senses. Every student of arithmetic is taught to prove his calculations, and similar ways of proving things observed by the senses is needed, says Prof. Hill.

Here Is Why Museum

Material Gathered from the Ends of the Earth Gives a Realistic Setting to Rare Natural History Exhibits



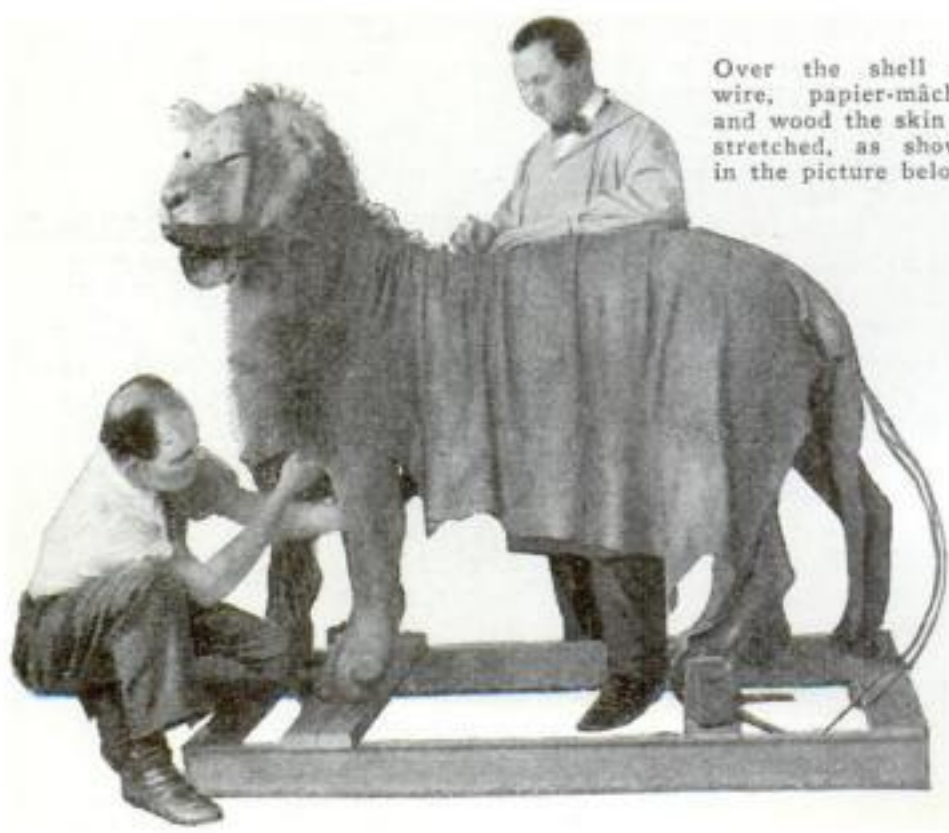
At right, the first step in mounting a lion, the making of a clay model. At the left, a plaster mold is then made.



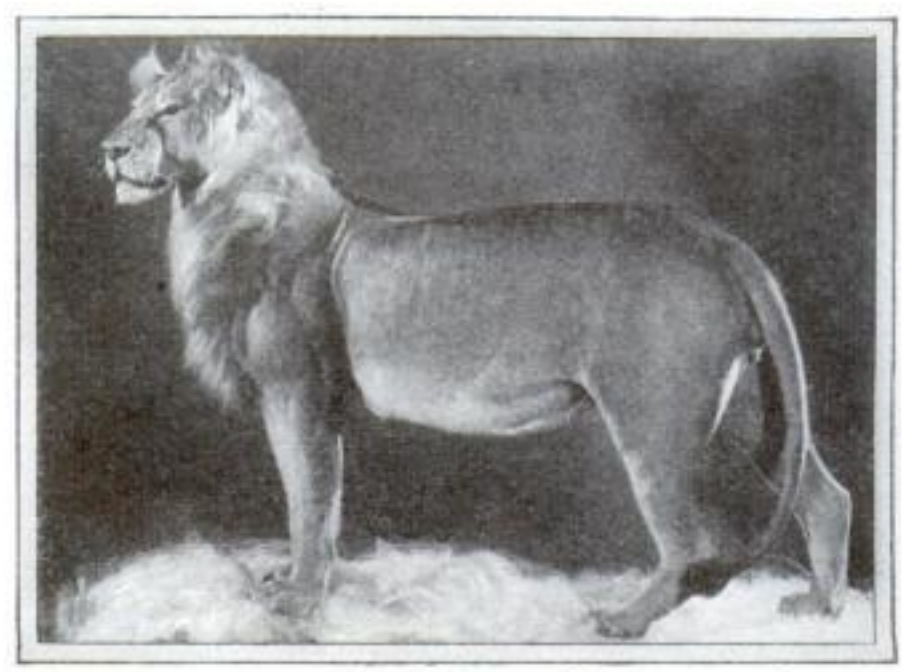
The third step is the removal of the plaster mold, as seen at left where half has been cut off and is lying on the floor. The clay model is destroyed to get second half of the essential plaster cast.

Next a papier-mâché form, reënforced with wire netting, is cast in the plaster mold as shown at left.

After the papier-mâché cast has set it is securely braced with wooden ribs, this work being done on half of the cast at a time after removal from the plaster mold.



Over the shell of wire, papier-mâché, and wood the skin is stretched, as shown in the picture below.



Seventh step, the completed lion, standing strong, permanent and lifelike. To exhibit him thus more work was necessary than would have been required to sculpture a likeness in bronze.

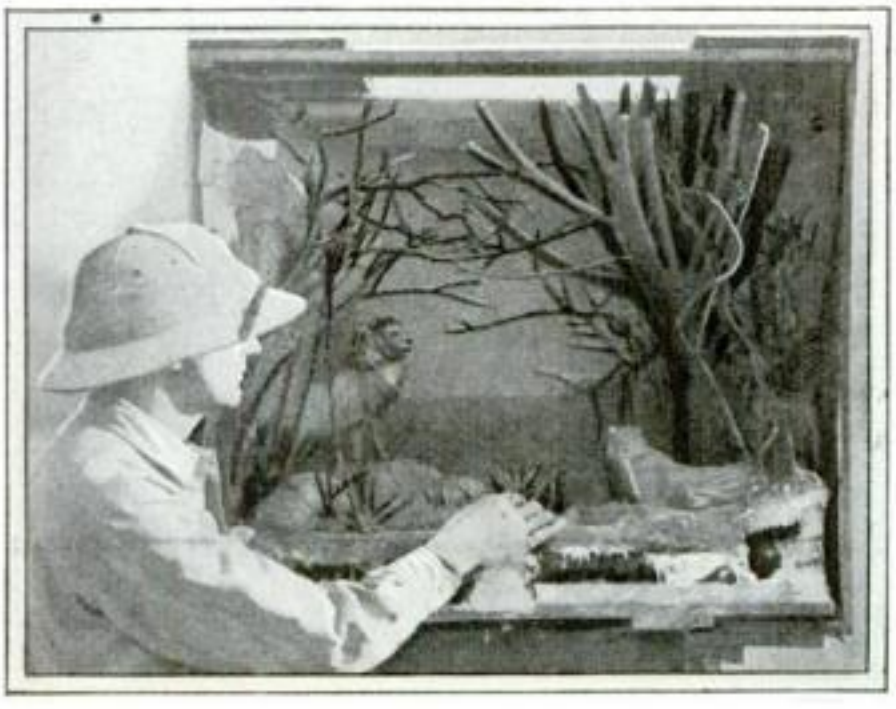
Beasts Are Lifelike

REALISM and accuracy of setting are demanded for all exhibits by the experts at the American Museum of Natural History, New York City. The photographs on this and the preceding page show clearly what pains are taken to mount specimens in an absolutely natural surrounding. To accomplish this, science and art join hands and the result is startling, as the utmost care is taken to give the mounted specimens a lifelike appearance in the midst of natural surroundings designed after long study in jungle and field on two continents.

The lifelike group of Indian tigers seen at left is one of the latest to be completed at the American Museum of Natural History. Note how the details of stream and forest give to it a striking impression of realism.

In the leopard's African home, W. R. Leigh sets up his easel and paints a landscape view for the museum's background.

Plaster casts of leaves from the jungle are made in an effort to secure absolute accuracy in the artificial home built for the dead specimen. This shop has been set up in the field near the source of supply so that material is handled while fresh.



James L. Clark, assistant director of the American Museum of Natural History, makes a model of an African lion group while encamped in the immediate neighborhood of its natural habitat.

Carrying limbs of the Euphorbia tree back to the field camp. There the branches are photographed, casts are made, and color notes recorded, to aid in reconstructing the wood for the exhibit's background.

New Helicopter Rises in Vertical Flight

Pescara's helicopter, in test flight, rose vertically and then skimmed across the field. With planes whirling it hovered like a huge bird.

AERONAUTICAL experts gathered recently at Barcelona, Spain, to see if one of the strangest of flying machines would take the air. The inventor of this helicopter, Raoul Pescara, a Spanish engineer, climbed into the narrow cockpit of the bare metal tubing. Above him, two giant "windmills" of eight blades each began to flail the air, while an ordinary airplane propeller at the front idled slowly. Then the craft rose bodily into the air, slowly and deliberately, as if its great weight had vanished. It dipped, and skimmed across the flying field. The helicopter was a success.

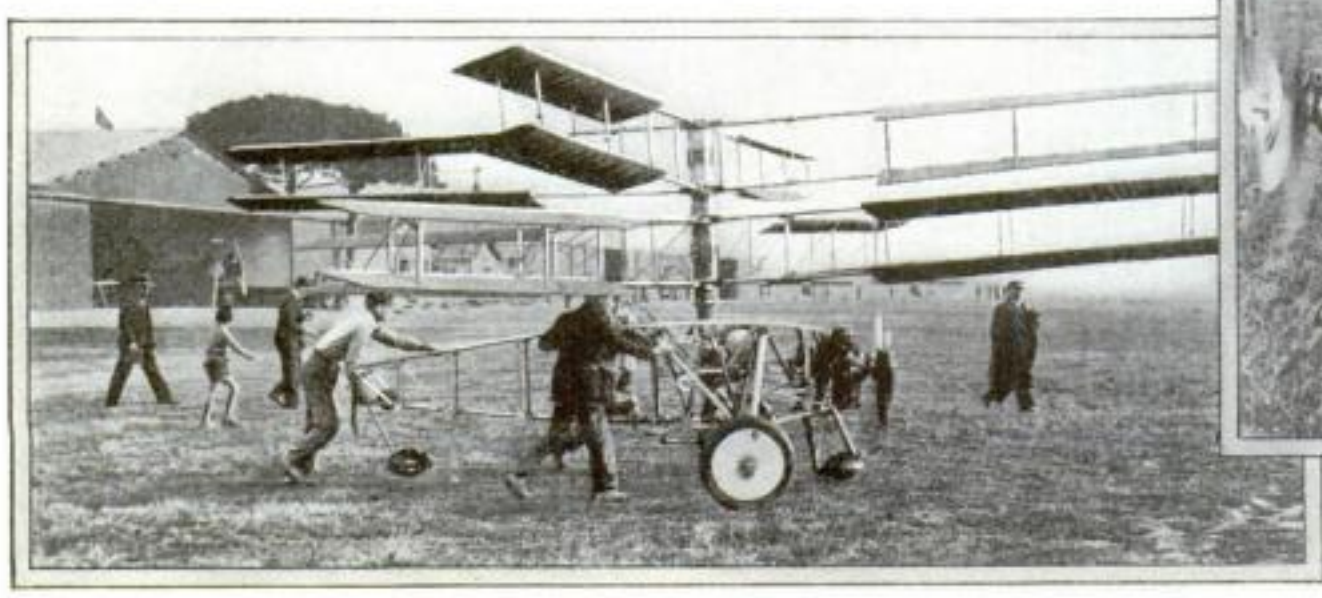
Its ability to rise straight up distinguishes a helicopter from any other type of flying machine, such as the autogiro described on page twenty-eight of this issue. Because a helicopter could use a roof top or a back yard as a landing field, instead of requiring an extended area, inventors have long dreamed of perfecting a vertical-flying craft. Only after a series of heart-breaking failures was the successful Pescara craft evolved, the indomitable inventor building one craft after another.

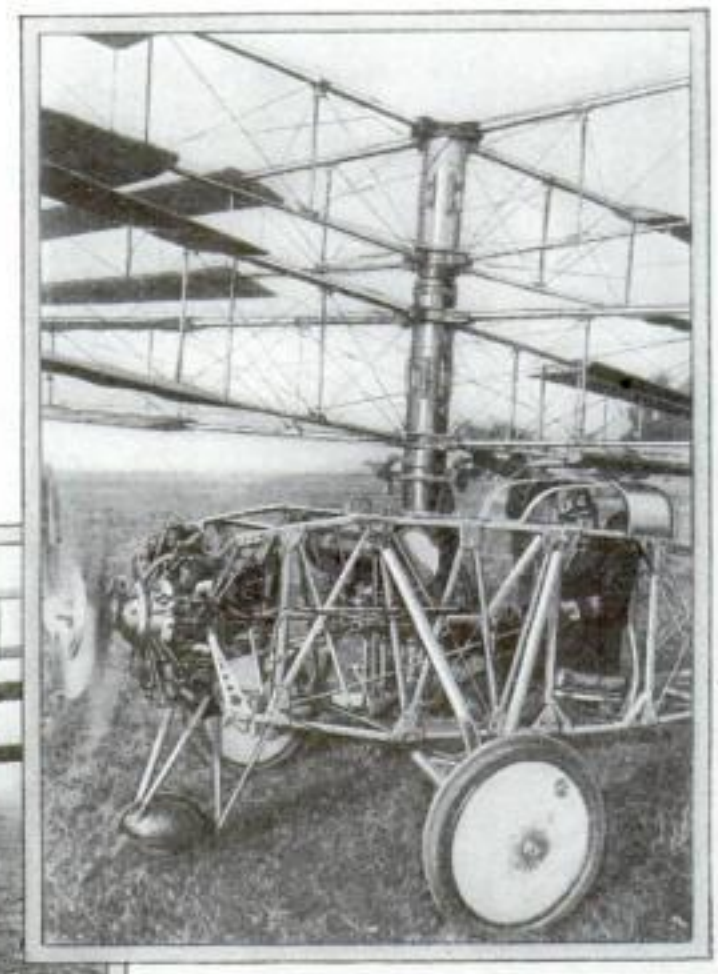
The first Pescara helicopter, built several years ago and described in POPULAR SCIENCE MONTHLY, could not rise because it could only lift three fourths its own weight. A second got off the ground but was unable to balance itself in the air. Another, when flown out the hangar door, tipped over and injured its pilot.

Keeping the machine upright was the problem that dogged the inventor, and he fashioned ingenious outriggers and attached them to the axles of his next craft's landing wheels. These short poles were tipped with shock absorbing "footballs." Pescara practiced piloting the craft until he learned to skim over the earth at the height of a foot or two, bouncing the poles off the ground with acrobatic skill whenever the craft started to tip. He holds the world's helicopter distance record of 2,414 feet made in 1924.

Recognition of Raoul Pescara's work came in 1927 when the British government commissioned him and an associate to build a helicopter. The present machine is the result of his latest studies.

Helicopters are being designed and built in this country but at present all official records for elevation and straight flight are held abroad.





Above, Raoul Pescara, Spanish engineer and inventor, in the cockpit of his helicopter. At left, the machine, taken out of the hangar, is pushed onto the field for test.

ACCURACY OF BEARING AUTOMATICALLY GAGED

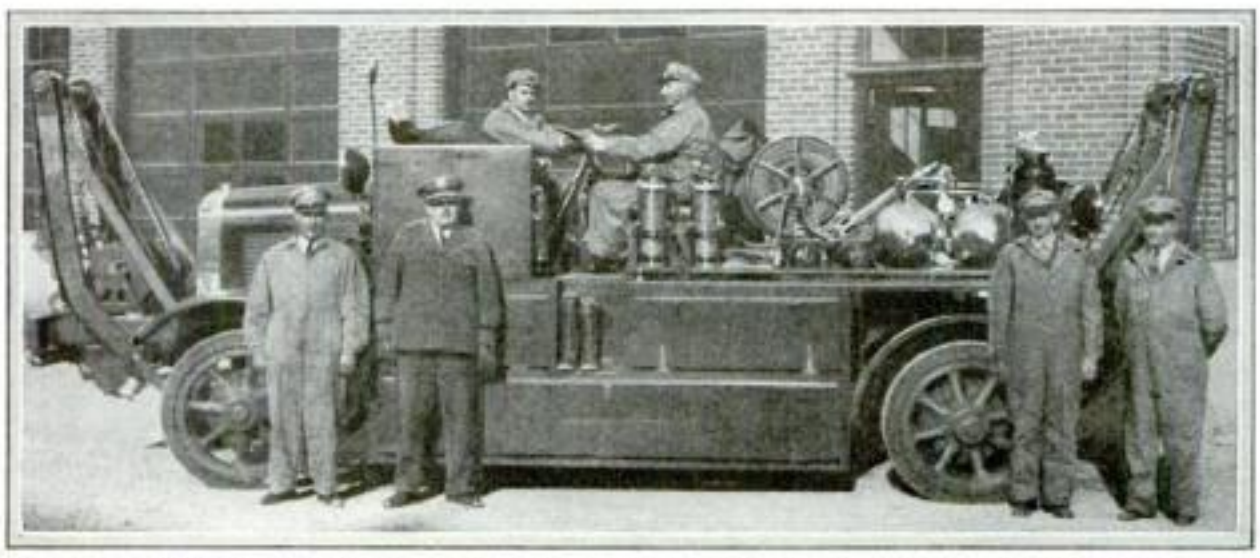
A NEW gage records on a dialed face how much a bearing is out-of-round. Based on the principle that it takes a three-point contact to determine a true circle, any deviation from true causes a pointer to move to the right or left.

Red markers are placed on the dial to permit setting the gage to tell when the bearing is above or below a certain limit, the limit being a point midway between the markers. The markers are adjustable.

TUNNEL TRUCK HAS TWO FRONT ENDS

EITHER end is the front end of an emergency truck with a reversible drive, recently put into service in the new international tunnel between Detroit, Mich., and Windsor, Canada. It can dash into the tunnel and tow out a balky car without turning around. Two drivers sit at the novel truck's steering wheels, facing in opposite directions.

This machine also carries twelve chemical fire extinguishers of the hand type and one 600-gallon power-driven extinguisher, with hose and reel. On the chance of encountering dangerous gas it is equipped with gas masks and apparatus for reviving asphyxiated persons.



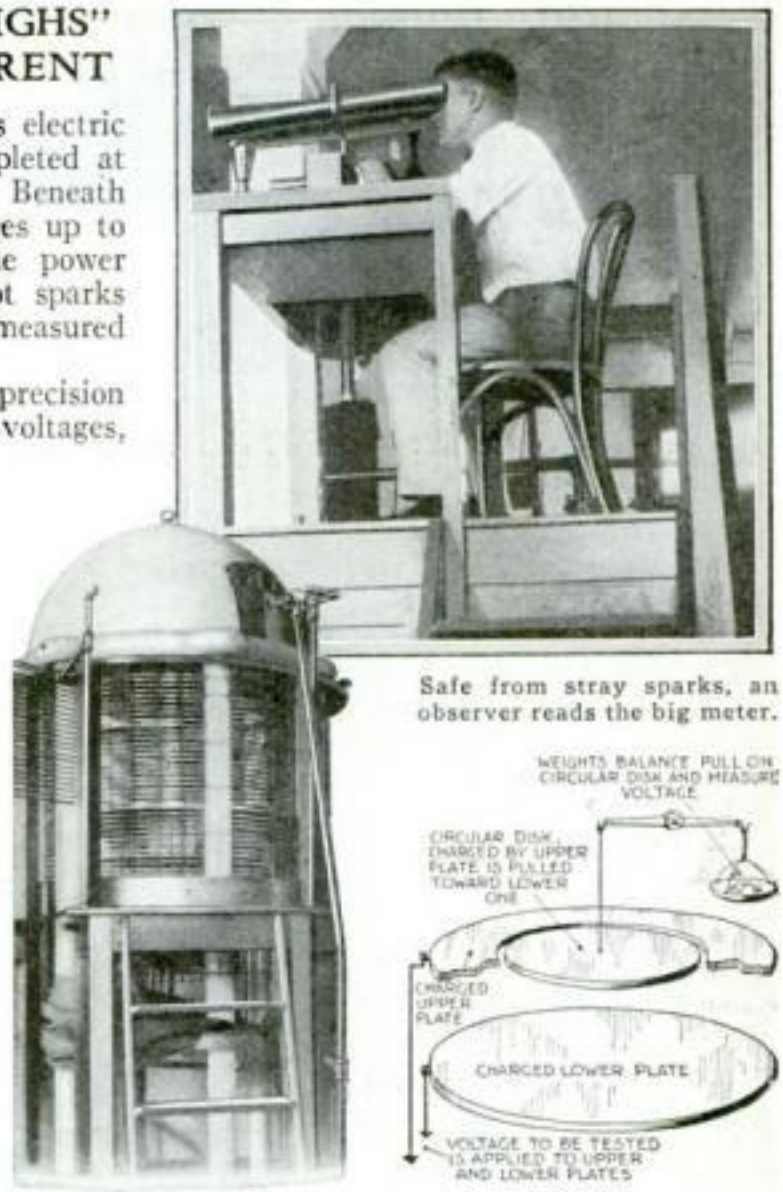
Designed for use in the new international tunnel between Michigan and Canada, this emergency truck, with two front ends, can go in and out of the tunnel without stopping to turn around.

LARGE METER "WEIGHS" HIGH VOLTAGE CURRENT

BIG brother of all the world's electric meters is a voltmeter just completed at the U. S. Bureau of Standards. Beneath its mushroom-shaped dome, forces up to 300,000 volts of electricity—the power that lies behind sizzling two-foot sparks of small-scale lightning—may be measured with hairbreadth accuracy.

This is the first available precision instrument to measure these voltages, though such an instrument has long been needed to check the accuracy of power transmission over standard 220,000-volt lines. In order to measure precisely extremely high voltages, the designer, Dr. H. B. Brooks of the Bureau's staff, devised an instrument that literally "weighs" electric voltage.

When the voltage is applied to two metal plates in the machine, a circular metal disk hanging in the center of the upper plate becomes charged and is attracted to the lower one. From a platform eight feet away, an observer works controls that add weights to the balance that carries the disk, until he sees through a telescope that it is level again. The number of weights he must add indicates the voltage.



Safe from stray sparks, an observer reads the big meter.

Electric meter that measures up to 300,000 volts. Diagram shows how the meter "weighs" voltage.

This log now serves as a garage for a tractor used in a California park.

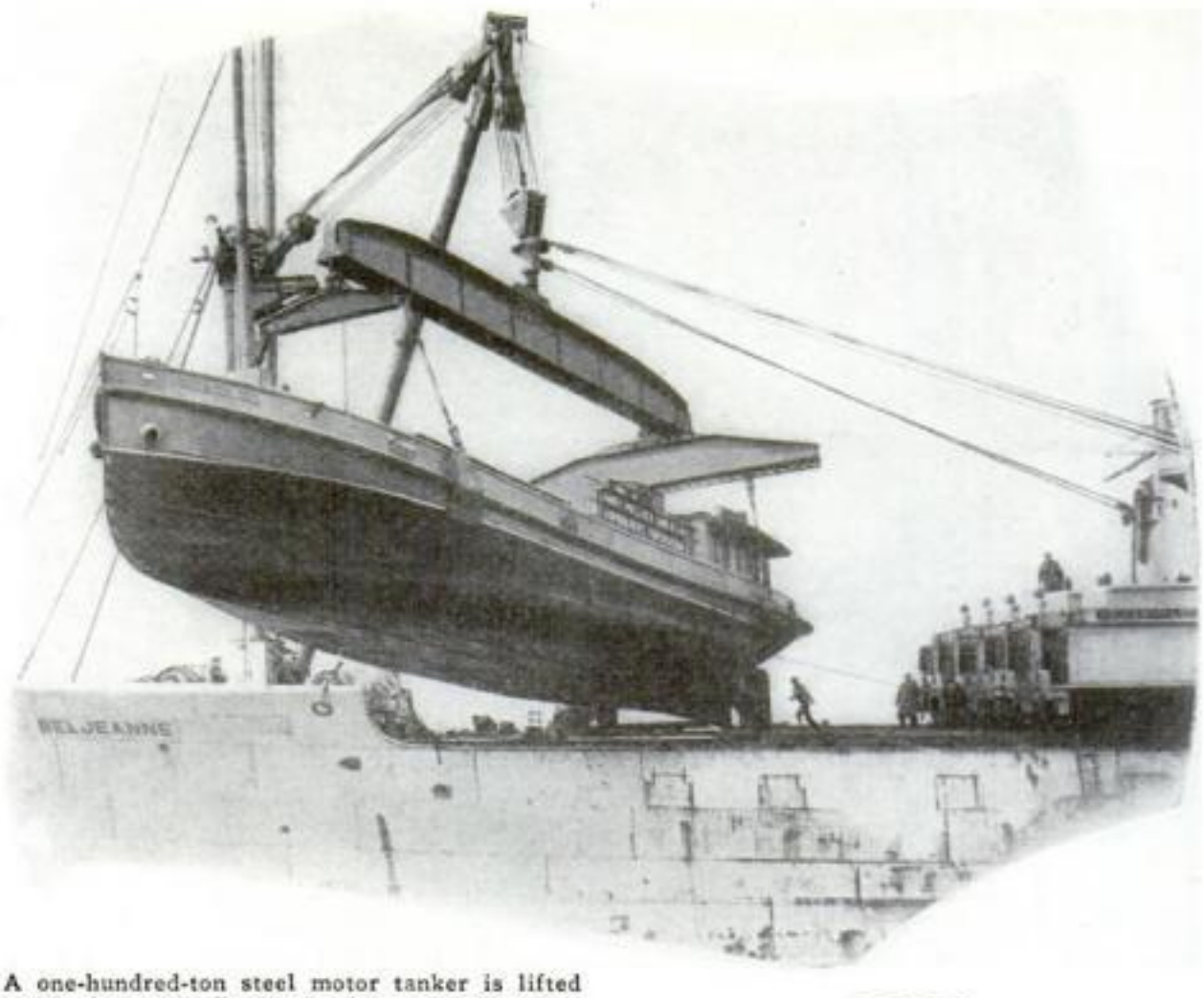
GIANT HOLLOW TREE IS TRACTOR'S GARAGE

A NEW use has been found for a huge hollow log in Balch Park, near Portersville, Calif. It serves as a garage for a small tractor used in improving the park grounds. The photograph above shows the tractor entering the log.

The remarkable relic, seventy-five feet long, has an opening fifteen feet in diameter. The interior is completely burned out from one end to the other. Park officials are carefully preserving it, after it has already survived many strange uses. Campers have frequently found shelter in the hollow tree, and now the fallen giant's rest is daily disturbed by the chug of the tractor going in for the night.

ONE-HUNDRED-TON BOAT IS LOADED ON LINER

ONE of the greatest lifting feats ever performed in shipping was accomplished recently at the mouth of the Thames River, in England, when the 100-ton steel motor tanker, *Itaca III*, was hoisted bodily aboard the liner *Beljeanne*. Although the big boat listed over as the load came aboard, her own derrick proved adequate for the ticklish task. Safely aboard and stowed on the top deck, the tanker was soon en route to Buenos Aires, its South American destination.



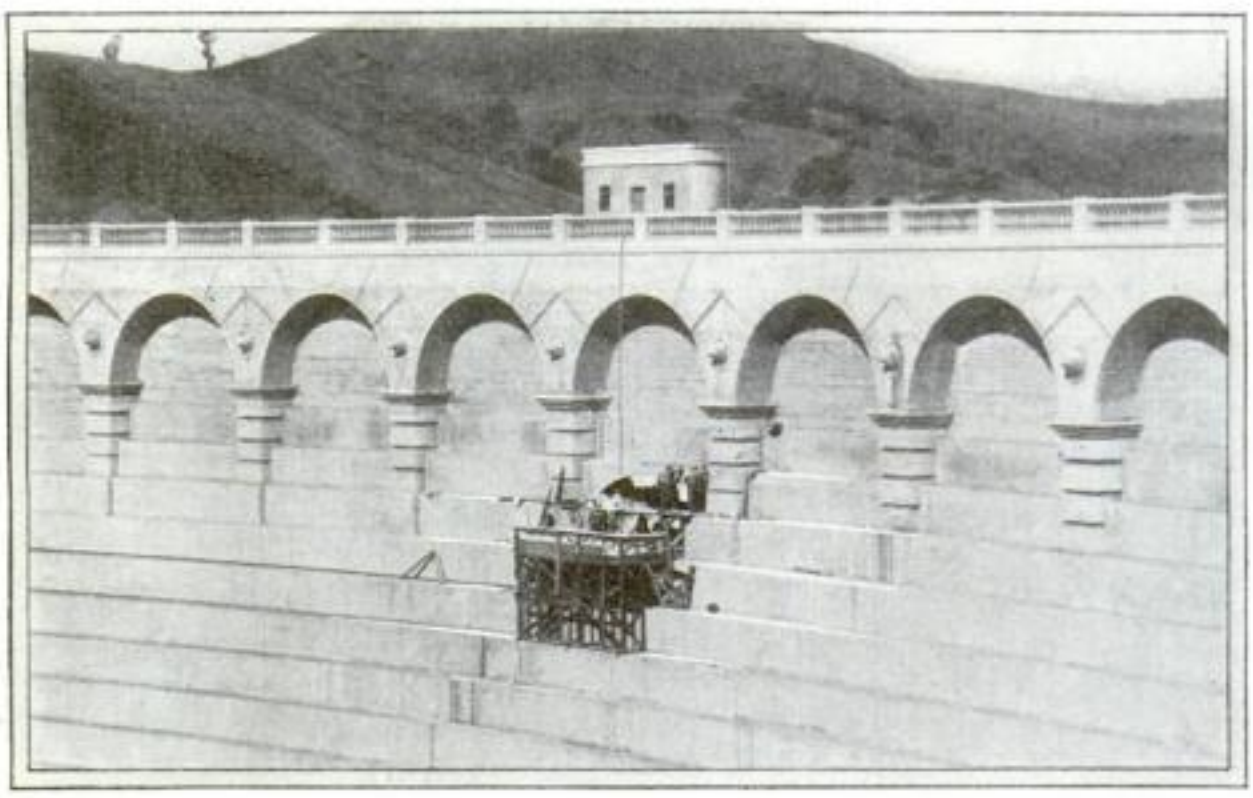
A one-hundred-ton steel motor tanker is lifted bodily by a big liner's derrick and hoisted on deck for shipment from England to Buenos Aires.

CLOSED AUTO DRIVERS VICTIMS OF NEURITIS

DRIVING in a closed car, with a front window open for signaling, may lead to neuritis, according to a recent report to the American Medical Association. Cold, damp weather increases the likelihood of contracting it in this way. Sufferers experience pain about the shoulder and neck, on the left side only. Medical authorities explain that air from the window circulates in a draft past the driver's left shoulder, and it is this local chilling that causes the ailment. Drivers of open cars are not affected, the report states.

NEW LAMP DISCOVERS STRAIN IN GLASSWARE

DID a piece of glassware ever fall to pieces overnight in your cupboard? If so it means simply that the glass was cooled unevenly in the factory and that its parts, always under a strain, were shattered by some trivial change of temperature. To prevent such an occurrence, a German lamp inspects glass objects for traces of strain before they leave the factory. The lamp produces polarized light, in which strained pieces of glass, ordinarily transparent, cast a shadow.



SAFETY OPENING BORED IN BIG WESTERN DAM

WORKMEN are engaged in cutting a hole through Mulholland Dam, near Hollywood, Calif. This unusual operation is for the purpose of providing a new spillway for the structure. It will act as a "safety valve" by allowing surplus water behind the dam to escape, relieving excess pressure on it. The work is part of the $39,000,000 program for improving and enlarging the water supply system of the city of Los Angeles, Calif.

The spot at which the Mulholland dam was built has long been considered one of the most beautiful in the West. In boring the safety spillway, it was necessary to erect a scaffold on the face of the dam from which workmen operate air driven drills that cut their way into the solid granite. In the photograph above, the upper portion of the hole can be seen.

At top, the shadows of strain in cut glass, due to uneven cooling in the factory, show plainly when lighted with new lamp which, above, is being used to find flaws in bottles.

ARMY TARGET PRACTICE NOW USES TINY RIFLES

ARMY target practice has "gone miniature" for the Ninth Infantry at Fort Houston, Texas. Air guns and .22-caliber rifles have been superimposed upon the barrels of thirty-seven-millimeter guns and are fired instead of the large ones.

To make firing more realistic, a tiny town with houses, factories, Army trenches and a moving train has been constructed. BB shot or .22 bullets strike the dry sand and throw a spray of the grains, giving the effect of the bursting of a one-pounder's high explosive shell. The gunner aims through the larger gun's regulation sight.

FIND RARE THORIUM IS POISON ANTIDOTE

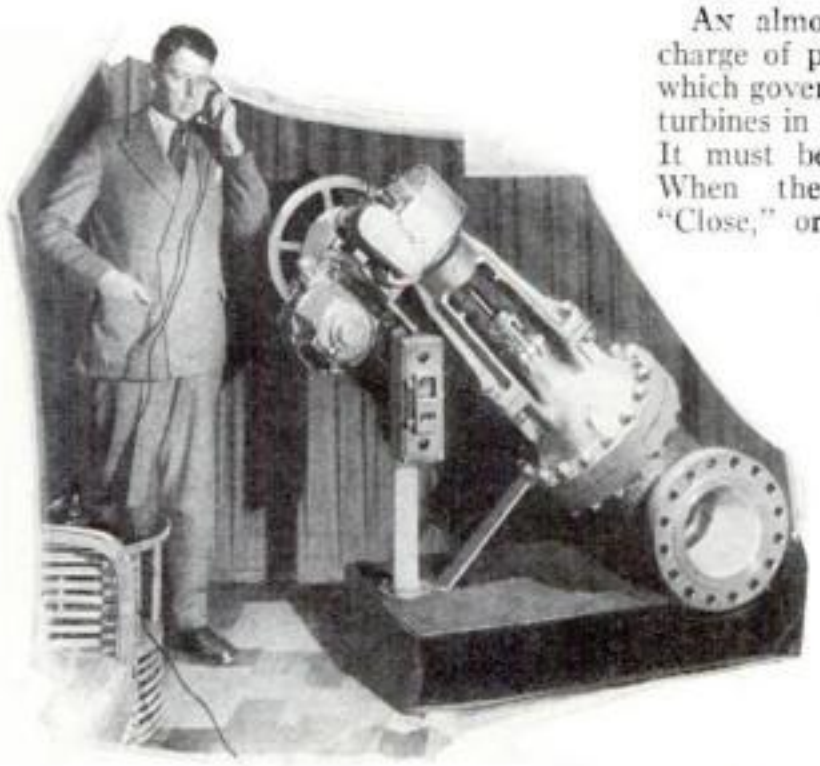
THORIUM, a substance that has radioactive properties, is an antidote for different poisons in living plants and animals, according to three French scientists, whose experiments were reported recently to the French Academy of Sciences. In one of their experiments guinea pigs, after an injection of thorium, were found to be immune to ordinarily fatal doses of vegetable poisons. The experiments suggest that this element may establish a similar immunity in human beings.

MINIATURE CAR MODELS USED IN SHOWROOM

A BERLIN, Germany, automobile dealer recently hit upon the novel idea of displaying small models of the machines he was selling. The tiny cars attracted more attention than the big ones without taking up nearly as much space in his showroom.

A lot of little models and one big car give this German auto showroom an attractive appearance, drawing many customers.

BIG TURBINE VALVE OBEYS HUMAN VOICE

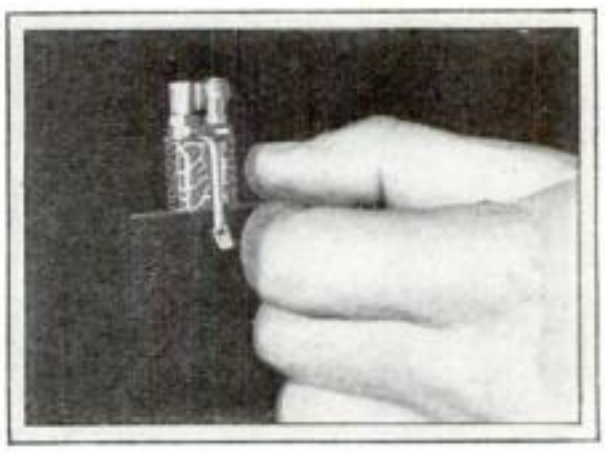


Payne Dean, New York City, with his recently invented steam valve that responds to spoken words.

AN almost-human servant of men in charge of power plants is this new valve, which governs the flow of steam into large turbines in response to spoken commands. It must be operated over a telephone. When the dispatcher says, "Open," "Close," or "Stop," the valve obeys his voice. The voice actuates a set of electric relays, through which the electric motor that turns the valve is controlled.

CHINA LIKES OUR HOMES

AMERICAN styles of wooden homes and buildings are becoming increasingly popular in China, says a recent report of the National Committee on Wood Utilization. Traditional pagodas are giving place to houses of American design and materials.



POCKET CLIP FITTED TO CIGARETTE LIGHTER

A CIGARETTE lighter that cannot fall out of the owner's pocket is fitted with a clip like those on fountain pens. The new lighter, with its ingenious pocket clip idea, is small and flat, taking up but little room in the pocket. In spite of its small size it can be used for about a week on one filling of fuel, according to its makers. Another advantage of the clip is that it keeps the lighter upright in the pocket, lessening chance of leakage.

ART BRINGS BEAUTY TO DESIGN OF ELECTRIC LOCOMOTIVES

In the future electric engines may have all the beauty of line that autos now have, as artists are designing them.

ART is applied to locomotive design in the new art-engineering department of the Westinghouse works at East Pittsburgh, Pa. Skilled artists make small clay models of electric locomotives under construction at that plant and after these are altered until the best looking engine is obtained, the model serves as a basis for the exterior design. The same staff of artist-sculptors helps to design other forms of electrical machinery as well as locomotives.

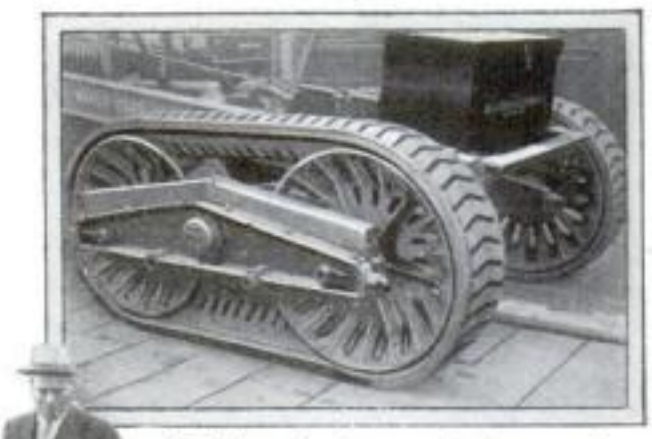
For a long while art has been an important factor in the design of motor cars, but its application to the design of heavy machinery is unusual. As a result the electric locomotive may soon be a sleek, trim monster, with all the shining gracefulness of a luxurious limousine.

The picture shows Donald R. Dohner, left, director of the art-engineering department of the Westinghouse company, drawing a design for a new development in accordance with the principles of art and proportion. At the right, Sidney Gould Warner is making a clay model.

NEW TRACTOR HAS RUBBER TREAD

A TRACTOR that crawls on rubber bands instead of metal tracks and which also shows marked differences in the design of the supporting frame recently was developed at Bucyrus, Ohio. Huge triangular-shaped bands of rubber are stretched over its driving wheels on each side, deep grooves in their surfaces giving a nonskid grip on the ground equal to that of a metal track. Screw adjustments on the driving wheel axles permit their center distance to be increased in order to tighten the crawler belt and maintain tension. Solid rubber tires on the front wheels also further reduce vibration and noise in operation.

Rubber crawlers allow the use of tractors on paved streets without fear of damage to the highway. They are also quieter in operation than steel-treaded machines and their manipulation under ordinary conditions is said to be satisfactory.



Rubber bands stretched around drivewheels of this tractor give traction and reduced vibration.

Rubber treads adjustable to maintain tension and rubber tires makes the tractor silent.

"STOLEN" SIGNAL WARNS OF AUTO THIEF

HARDY indeed is the thief who would risk driving away in a car equipped with a new antitheft signal invented by a mechanic of Pittsburgh, Pa. At the first application of the brake, the word "STOLEN" appears at the rear in brilliant blue-green letters. The owner of the car upon parking it sets a secret switch that operates the device.

AIR PROPELLER ON FLAT-BOTTOMED BOAT

Hubert Richmond, of Miami, Fla., in his flat-bottomed boat to which he fitted a motor-driven air propeller.

AN "AERO" motor of his own construction enabled Hubert Richmond, of Miami, Fla., to convert his rowboat into a motorboat and still use it in water so shallow that it will barely float the boat.

From a discarded, twenty-two-horsepower motorcycle motor and an air propeller, he built a power unit that is clamped to the stern of his rowboat. A tiller handle similar to that of an outboard motor steers the craft by turning the air propeller from one side to the other. On a straightaway, the "pusher" propeller drives the boat at a thirty-mile-an-hour clip.

The motor is detachable and portable. A counterbalanced built-up crank shaft has been substituted for the flywheel ordinarily found on motors of this type. Richmond, an inventor, claims originality for his device.

Frank Sfara, Pittsburgh, Pa., exhibits his device intended to prevent stealing of cars.

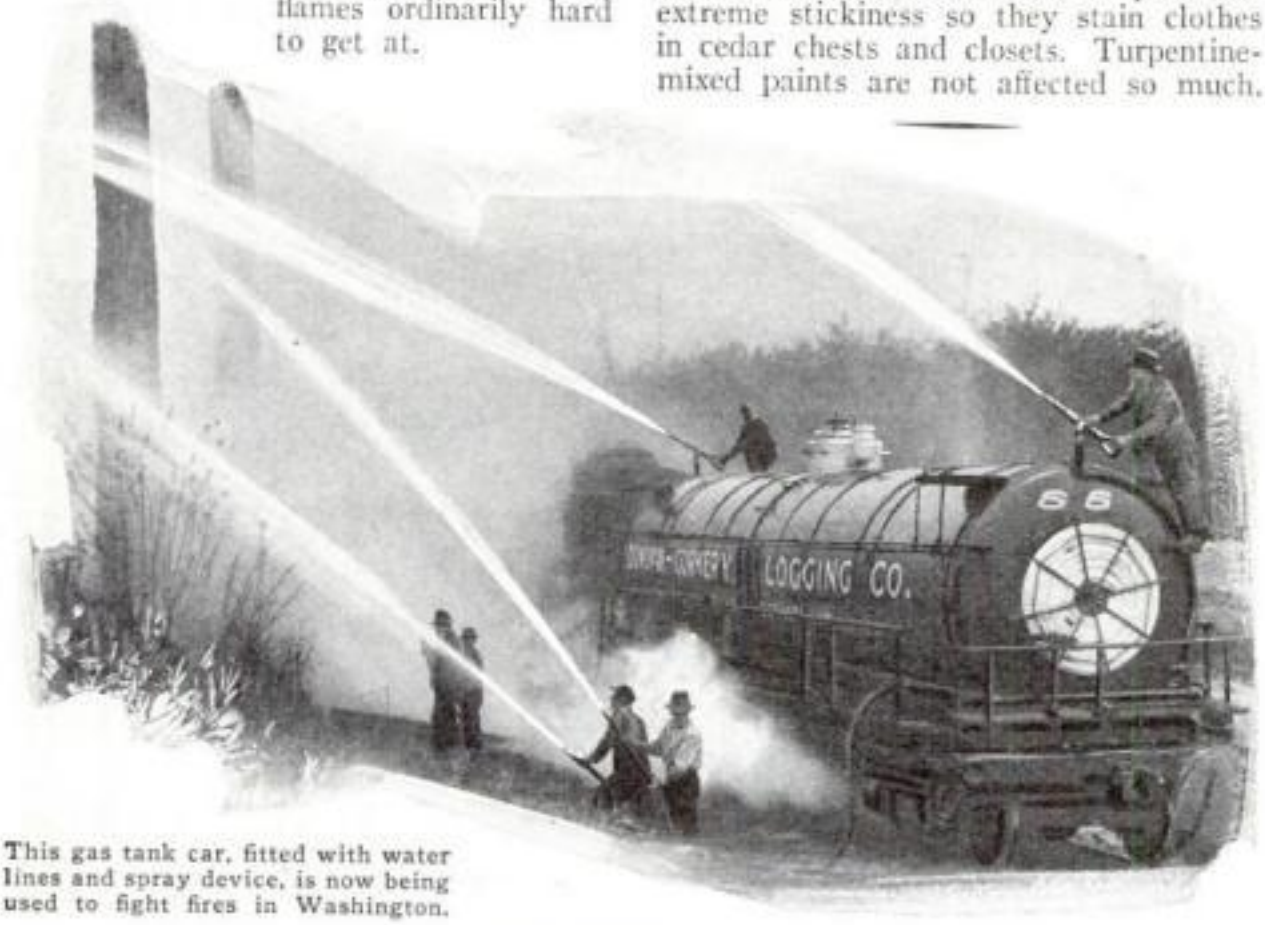
HOW CARS ARE WRECKED

MOTORISTS who crowd around wrecked cars frequently cause additional accidents, says Robbins B. Stoekel, state commissioner of motor vehicles, Connecticut. Automobile wrecks generally occur at points on highways where the vision of drivers of approaching cars is obscured and crowds increase the danger. If help is on hand, motorists should keep moving.

TANK CAR CONVERTED INTO FIRE ENGINE

WHILE Federal agencies were perfecting the methods of fighting forest fires described on another page of this issue, an Aberdeen, Wash., logging firm converted a gasoline tank car into an ingenious fire engine of its own.

The unique car can fight fires in three ways. Nozzles like those of a fire boat, on top of the car, may be aimed in any direction to spray powerful streams at near-by flames. More distant fires are fought with hose, unreeled from the car. A sprinkler system beneath it showers water upon blazes under the ties of bridges, or in brush alongside the rails. Water pressure is supplied from the locomotive that pulls the car. The tank has been fitted up with a number of large water lines in which the pressure is sufficient to throw water over a hundred feet on each side of the track and thus furnish efficient protection to the company's right of way. The sprinkler system is an especially important feature, as with it water can be thrown on flames ordinarily hard to get at.



This gas tank car, fitted with water lines and spray device, is now being used to fight fires in Washington.

GHOSTLY UNIFORM FOR BRITISH POLICE

MASKED riders in black now roam the streets of London on any rainy day. A speeding motorist finds the hooded apparition that draws up beside him is a motorcycle officer, clad in the latest rainproof uniform. The headgear protects the rider's face, while a visor shields his goggles from the rain.

Grotesque apparitions, clad in ghostly attire, are familiar sights in London as motor cops don this rainproof uniform.

CEDAR VAPORS SOFTEN PAINT

CEDAR vapors, unhealthy for moths, also are unhealthy for paints, according to recent discoveries of the United States Department of Agriculture. They act as slow solvents of drying oils used in mixing the paints, softening them to a point of extreme stickiness so they stain clothes in cedar chests and closets. Turpentine-mixed paints are not affected so much.

NEW ELECTRIC TRUCK STEERED WITH FEET

THE operator of a new German industrial truck stands on a small platform mounted on a horizontal axle. Tilting it to one side or the other by pressure of his right or left foot steers the vehicle to right or left as desired, leaving both hands free to control power and brakes. Steering by the operator's platform in this fashion makes a compact machine, with the greatest amount of loading capacity on the shortest wheelbase and turning circle.

The operator finds no difficulty in maintaining his balance upon the steering platform even on turns, because he has only to respond to the natural instinct to lean in the direction of the turn, exactly as a skilled rider does in guiding a horse. The foot-steered truck, it is claimed, materially increases the efficiency not only of the operator but of the machine itself.

The operator's hands are freed from task of steering this truck, which is guided by feet.

TOOL CHECKS OBJECTS' SHAPE AND SIZE

Shape and size of round objects are determined to one half thousandth of an inch by this tool.

A NEW tool for checking shape and size of any spherical object, from three fourths to six inches in diameter, accurately indicates inaccuracies in half thousandths of an inch. It makes possible the rapid checking of pistons, bushings, sleeves, and pins. The part to be checked is slid into the V-base of the tool and revolved slowly. The dial shows the shape and contour of the part and registers inaccuracies.

COFFEE FILTER IN POT

A NEW German filter permits ordinary coffee or a caffeinless beverage to be poured from the same pot. It is made of black material resembling blotting paper, which contains specially-treated charcoal, similar to that used in gas masks to absorb poison gases. The filter is used when pouring coffee for those who object to caffein.

FILMS PUT CRIME IN FAR EAST ART

A native Bali sculptor carves on the wall of a temple his idea of an American hold-up and, at left, a bicycle rider. In top illustration, carvings show, among other things, flying airplanes and a fisherman trying to hook a fish.

It is a long way from America to Bali, a little island adjoining Java in the Dutch East Indies, where brown-skinned natives loll in the tropic sun. But now and then a ship visits Bali with a few reels of Western movies, and the natives flock to see them. On the wall of one of their temples may be seen the effect of the impression that movie thrillers have made in their minds.

Automobiles, bicycles, and airplanes have been carved in stone on the temple walls, in company with native figures of gods and demons. One scene even depicts an armed gangster holding up a car, in traditional bandit manner.

Frequently an earthquake damages a temple wall, and when a new one is substituted it is decorated by a volunteer artist in stone. Evidently the movies furnished several with their inspirations.

Bali is only seventy-five miles long, with a population of 525,000. The natives are credited with being of a superior mentality and already had reached a high stage of culture when the Dutch took over the little island in 1849. They are especially adroit at sculpture and the walls of their temples are always elaborately decorated.

The photographs above show a few samples of the carvings on the temple walls.

CAMERA ON POLE SNAPPED FROM GROUND

This German invention in the form of a telescopic pole raises a camera above an obstacle to snap an otherwise hidden view.

Many an amateur camera user has wished at some time that he could climb to an elevated vantage point to snap a scene over crowds, tall fences, or other obstructions. Now a German invention, a portable "stilt" for the camera, makes such shots easy. A telescoping pole with a tripod screw at one end to hold the camera and a foot rest at the other to steady it holds the camera high aloft while the photographer works it from the ground. One model, designed especially for amateurs, becomes disguised as a cane for carrying. A professional model has no such refinement, but additional sections give it greater height in the raised position.

TAXI LIKE HANSOM CAB

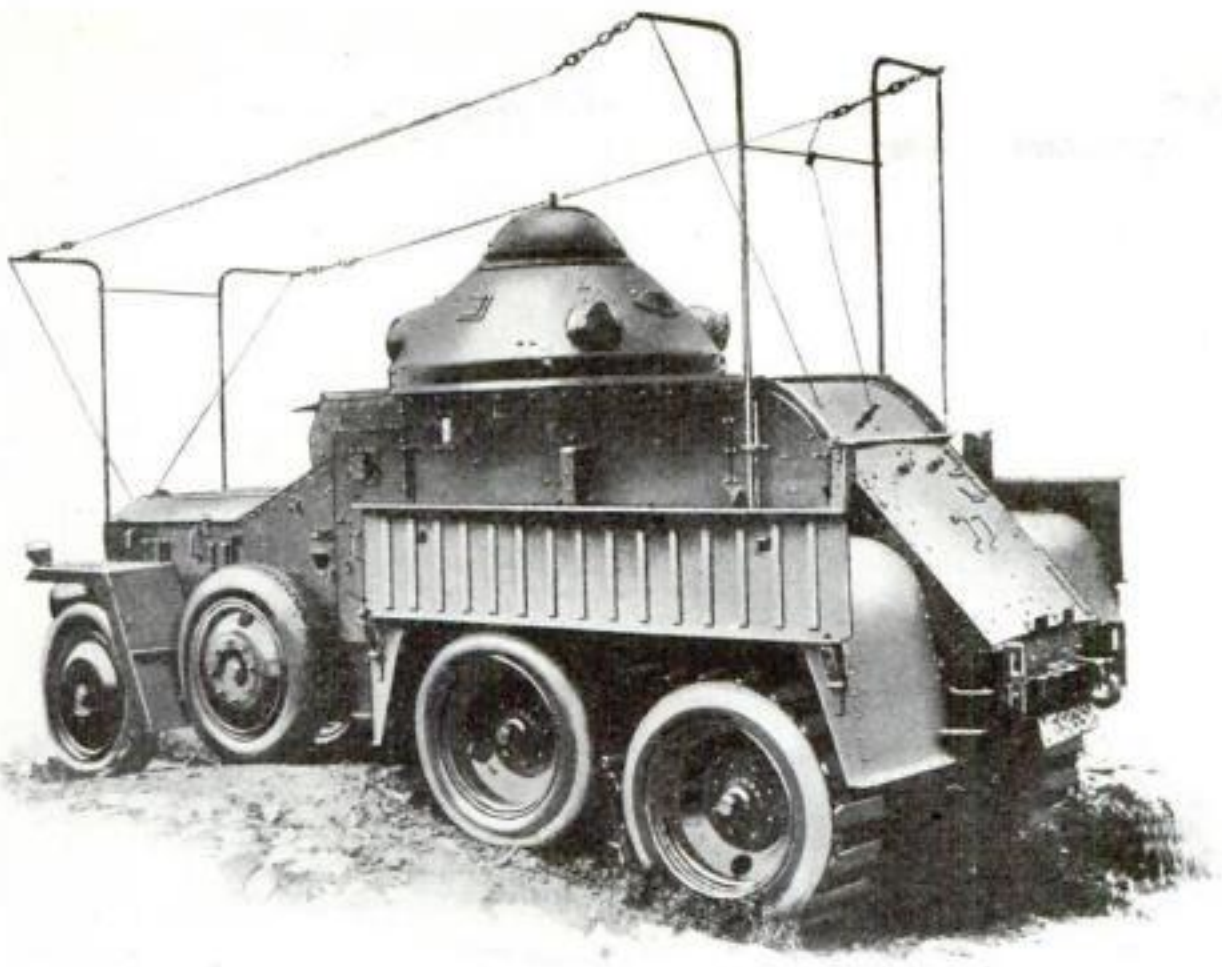
Taxicabs with engines at the rear and drivers sitting on elevated seats may revive the style of the old-fashioned hansoms. Sir Herbert Austin, British motor car manufacturer, suggests that cabs built along these lines might help to solve the traffic problem. Putting the engine at the rear would result in a car with much shorter wheelbase than those used at present.

LIGHT IN STOVEPIPE GUARDS WATER TAP

A piece of old stovepipe and a small electric light bulb form an antifreeze combination that saves the water pipes in the poultry yard of a poultryman near Lafayette, Ind.

The discarded stovepipe is placed around the water tap and, with the lighted electric bulb inside it, the top is covered with a heavy sack to prevent the heat from escaping. When thus protected the tap will not freeze even in the coldest weather.

H. W. Fitting, poultryman, Lafayette, Ind., guards water tap with light and stovepipe.



NEW ARMORED CAR IS RADIO EQUIPPED

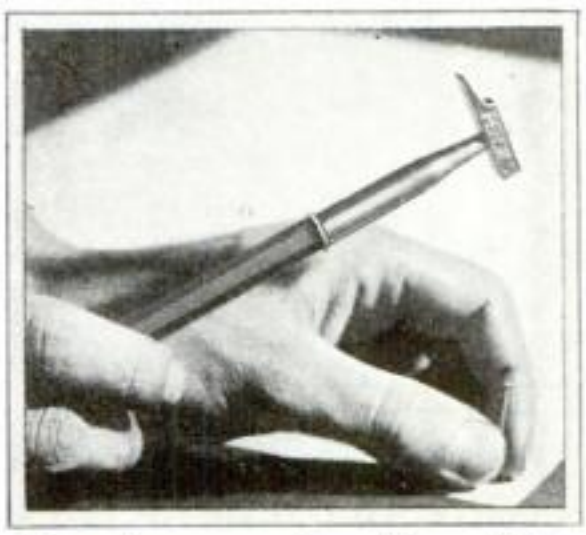
A GROTESQUE, humpbacked vehicle is the newest in armored cars, recently adopted by the British army's tank corps. Six of its eight wheels usually suffice to carry it over the ground, but a spare pair is pressed into service when it encounters extra rough going, as seen in the photo.

An added touch of oddness is a radio aerial strung on four L-shaped standards that enables the occupants of the car to keep in touch with their base during all operations. This novel use of radio was recently proved feasible in British tests of a wireless set installed in a tank (P. S. M., Jan. '31, p. 71). The apparatus consisted of portable receiving and transmitting sets.

PENCIL PROTECTOR CLIP IS A SMALL HAMMER

A PENCIL becomes a small hammer with the addition of a novelty clip at its end. It makes a really practical instrument for hammering small nails, tacks, or pins, and is useful for framing pictures and for other light work. A long shank gives a firm enough grip to keep the hammer part of the device from twisting when a blow is struck. The clip also serves to protect the point of the pencil from breakage in the pocket when not in use.

With the aid of the combination tool, lines may be marked for nails and the brads driven home without stopping to look for a regular hammer. The tip may be magnetized, if desired, to pick up brads or to hold nails for hammering nails in inaccessible places high above the user's head without the necessity of using a step-ladder or other support.

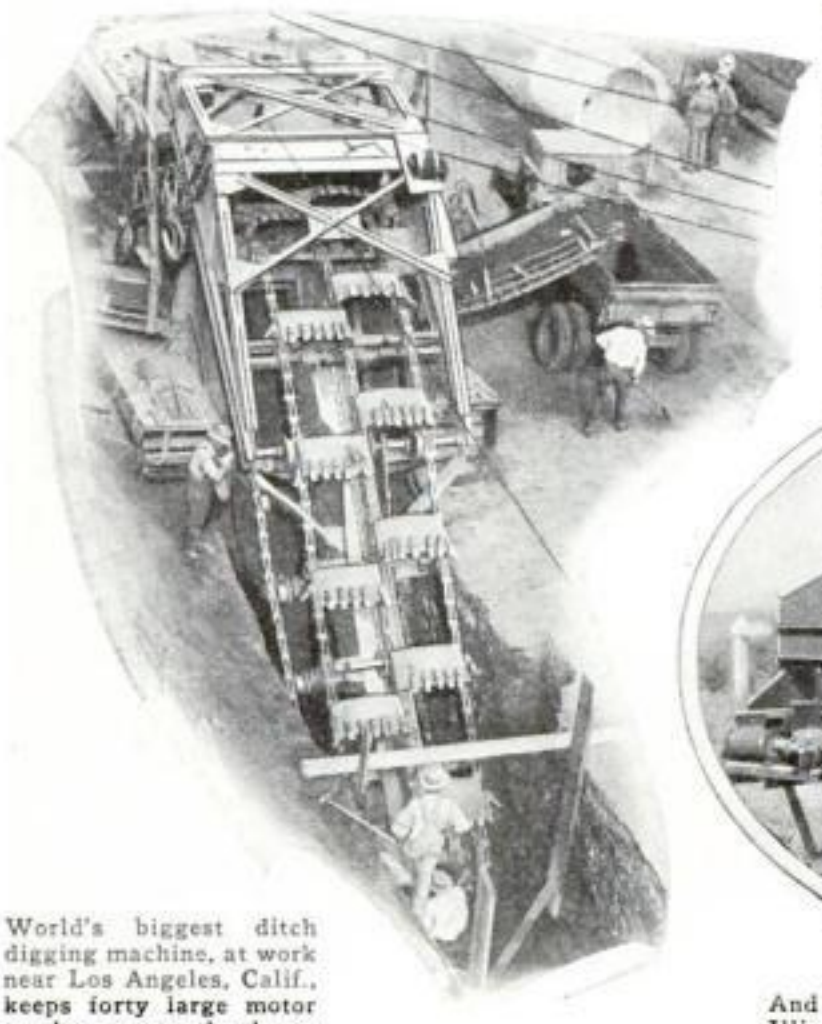


The metal protector clip on this pencil also serves as a light and convenient hammer.

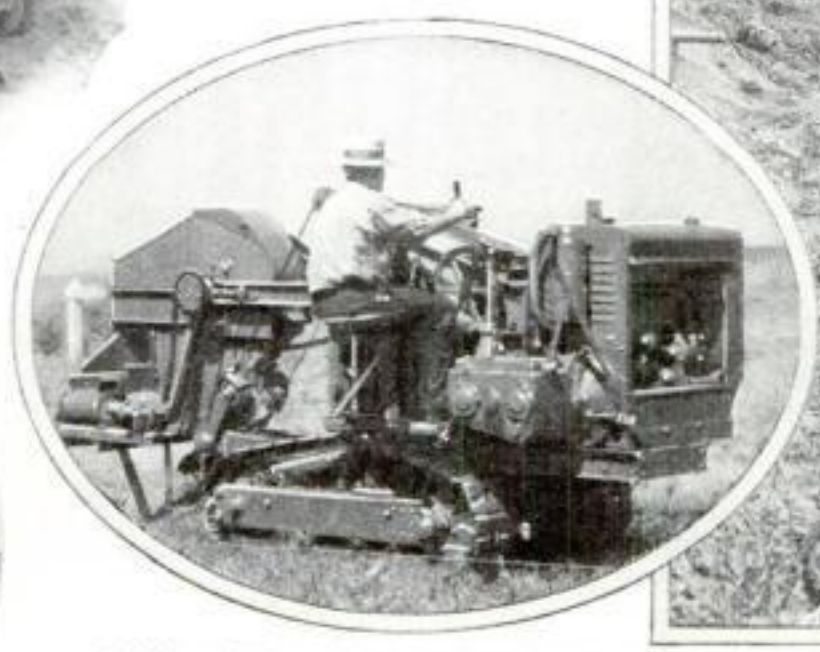
GIANT DITCHER KEEPS 40 TRUCKS BUSY

EXTREMES in the size of mechanical ditch diggers are in operation at Los Angeles, Calif., and Aurora, Ill. What is believed to be the largest ditch digger ever constructed is excavating a ditch for a large pipe line in the Jefferson Storm Drain District, near Los Angeles. The huge mechanical monster excavates more than six cubic yards of earth every minute, and keeps a fleet of forty large motor trucks busy hauling the earth away.

Only one man is required to operate a gasoline-motor-driven midget excavator which was recently developed at Aurora, Ill. This machine digs small trenches at the rate of from fifteen inches to twelve feet a minute. It will excavate trenches up to three feet deep and eight inches wide. A special device on its drive chain stops the digging buckets, without stalling the engine, should an obstruction be encountered in the trench.



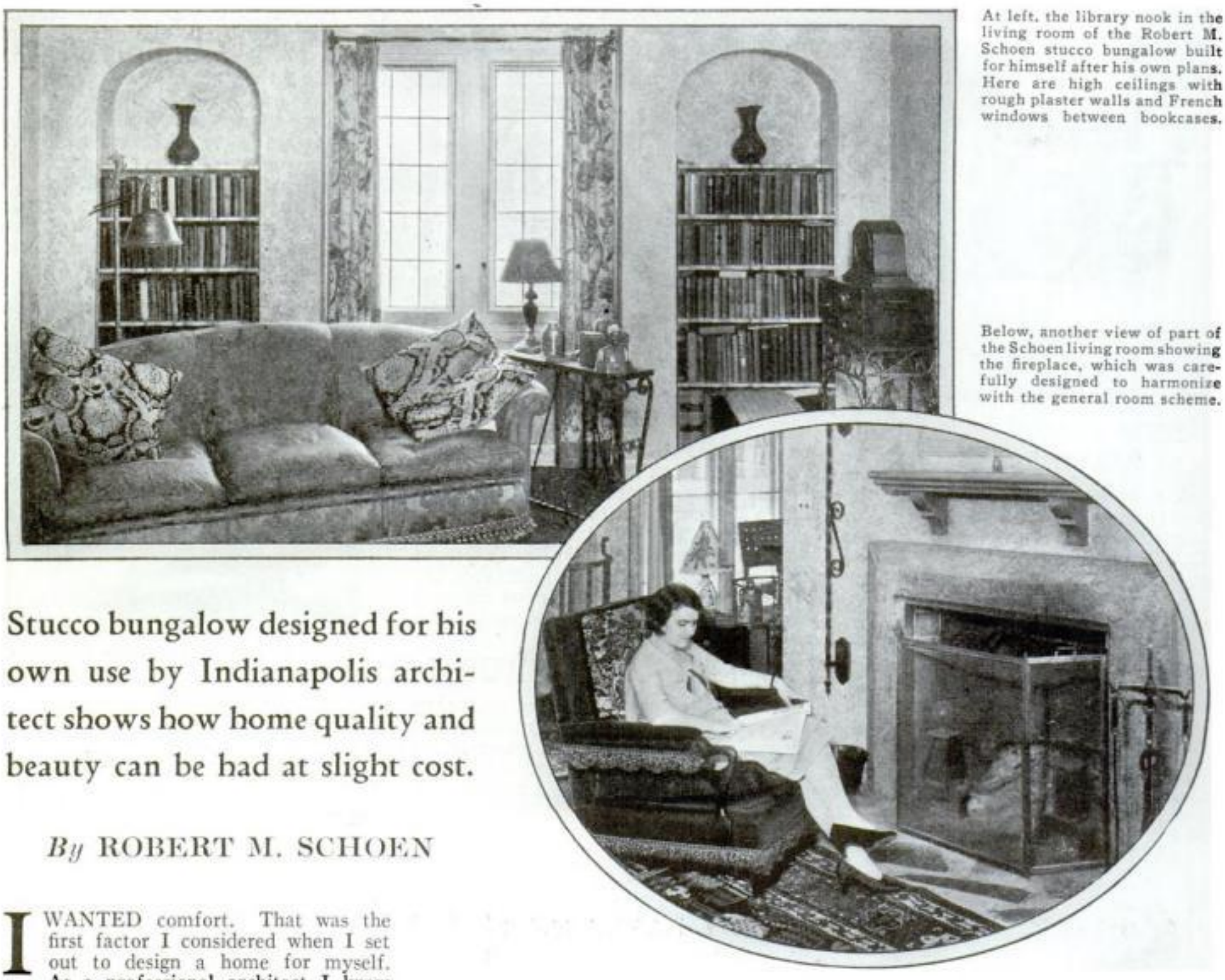
World's biggest ditch digging machine, at work near Los Angeles, Calif., keeps forty large motor trucks constantly busy.



And here is the tiniest ditcher of them all swiftly scooping out a trench across an Illinois farm. It is capable of cutting a ditch three feet deep and eight inches wide.

The Architect Builds His Own House—

This Home Planned for Comfort



At left, the library nook in the living room of the Robert M. Schoen stucco bungalow built for himself after his own plans. Here are high ceilings with rough plaster walls and French windows between bookcases.

Below, another view of part of the Schoen living room showing the fireplace, which was carefully designed to harmonize with the general room scheme.

Stucco bungalow designed for his own use by Indianapolis architect shows how home quality and beauty can be had at slight cost.

By ROBERT M. SCHOEN

I WANTED comfort. That was the first factor I considered when I set out to design a home for myself. As a professional architect I knew that I ought to practice what I preach and therefore include all of the latest and most modern ideas consistent with the size and general plan of the house.

Considering the size of home I wanted and the necessity for designing it in keeping with surrounding homes, I decided that $12,000 would be my price limit. I felt sure that I could plan a home that would fit in with neighboring houses and compare favorably with them, size considered, at that figure.

On these theories, I selected a stucco bungalow to accommodate my family of three. To use the word that best describes the structure to me, I wanted it to be "squatty." Right at the start I abandoned any idea of following a definite style of architecture.

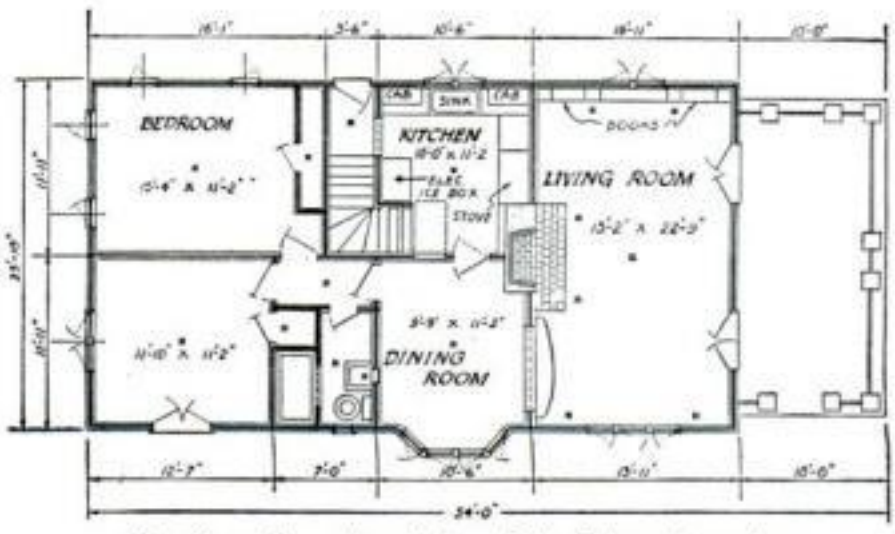
When drawing plans for a house, regardless of its size, an architect must bear in mind the number of pieces of furniture that ordinarily would be used in each room. He must see the room as it will be outfitted and try to keep his plans in harmony with the furniture that will go into it.

This plan probably savors of the crossword puzzle, but the results are astounding. I believe the system is worth a trial by any small home builder.

To begin with, I wanted a full-house width and a Colonial front porch. Rectangular in shape, the lowness of the entire structure is emphasized by the thick, grouped pillars at each end and the two in the center of the porch. A railing on the porch roof gives an ornamental balcony appearance.

In order to set off this exterior, I placed the house on the rear of the lot, allowing an uninterrupted view from the front broken only by a tree and a few shrubs.

Two flagstone walks join the drive to the two-car garage in the rear. One leads to the front porch and the other to an informal side and rear entrance through French doors to a bedroom.



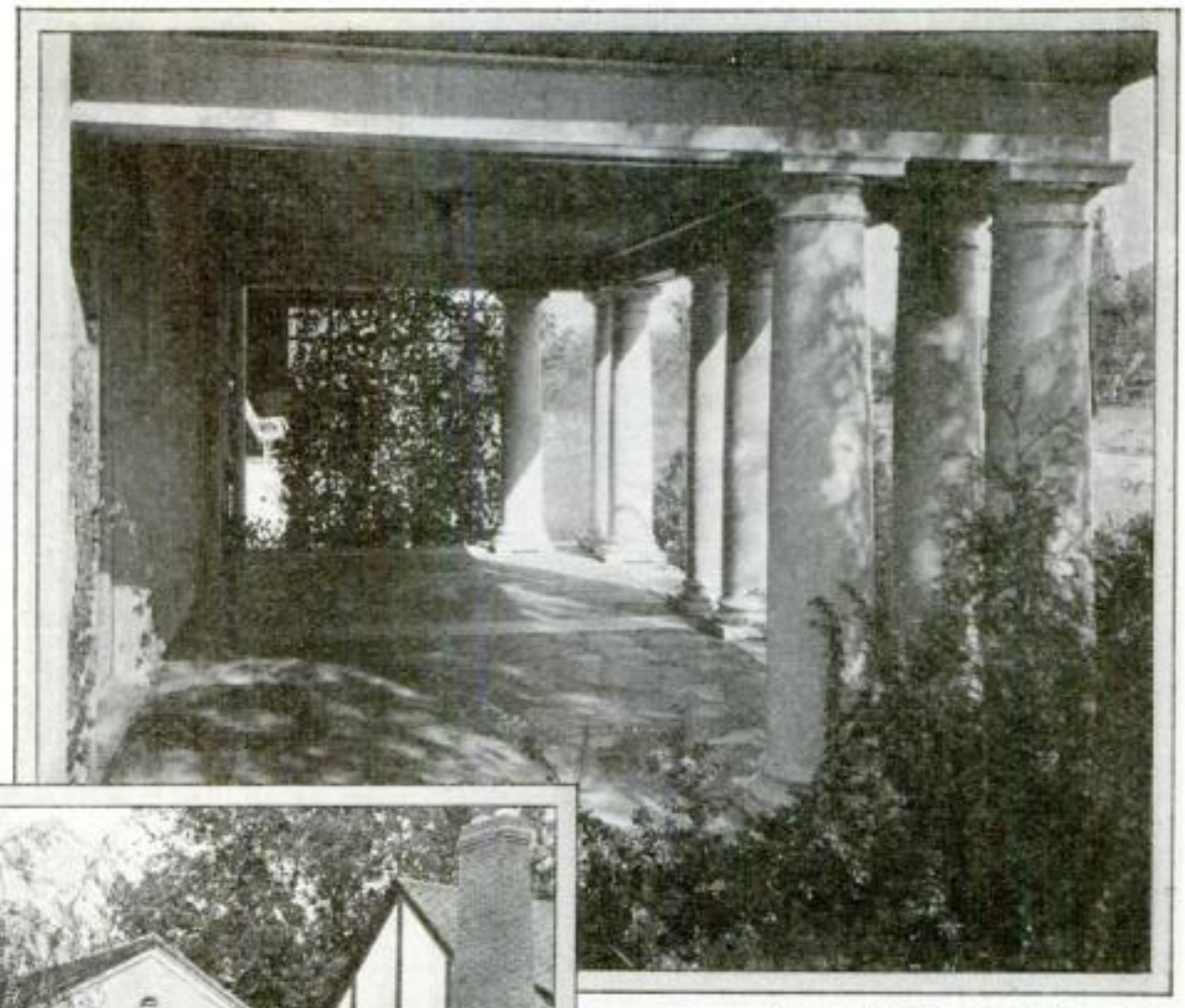
First floor dimensional plan of the Schoen bungalow.

The use of flagstone flooring on the front porch proved highly pleasing and successful. In contrast with the stucco exterior of the house and the white concrete pillars supporting the roof of the porch, the result is satisfying.

Two sets of French doors open onto the porch. A mail chute is situated in the porch wall between the entrance from the walk and the first set of doors.

From the Colonial type porch, I shifted to a living room of the studio design, with high ceiling and rough plaster walls. The French doors that lead to the porch have been supplemented with full length French windows at one end of the long living room and, at the other, with similar half length windows.

The latter set of windows is located between two built-in bookcases, to accommodate which the walls are extended several inches, giving niche effects on either side of the windows which are emphasized by the curving of the ceiling upward and



Front view of the house with massive, grouped pillars that emphasize its lowness.

Side and front view of the Schoen home. Garden and walks were planned to fit architecture of the house.

A view of the dining room as seen from living room. To break continuity the dining room is on a higher level. Note wrought iron banisters at each side of the entrance.

inward from the walls.

I took special care in planning the fireplace. Above the mantelshelf I placed a rectangular anaglyptic of Spanish Galleons at sea. To continue the harmony I placed similar plaques, of different designs, at the bases of the chandeliers in the living and dining room ceilings.

In addition to the plaque I have used craftex not only on the mantelshelf, but also on the protruding stonework edging the fireplace above and at the sides.

A fireplace not in use has a deadening effect on the brightness of a room. In order to prevent this, without using a heavy screen except for protection while the fire is burning, I installed a swinging fire crane, attaching a copper kettle to it. The devices used for firing stand beside the fireplace and are of wrought iron to harmonize with the drapery rods and cranes above the windows and doors. I also have installed long, wrought iron torchiers that drop vertically on each side of the fireplace.

With such a long living room, it was desirable to break the continuity between it and the dining room. To accomplish this I built the living room at a slightly lower level than the remainder of the house, placing a step between the two rooms.

A wrought iron scheme is used in the curved banisters at each side of the step.

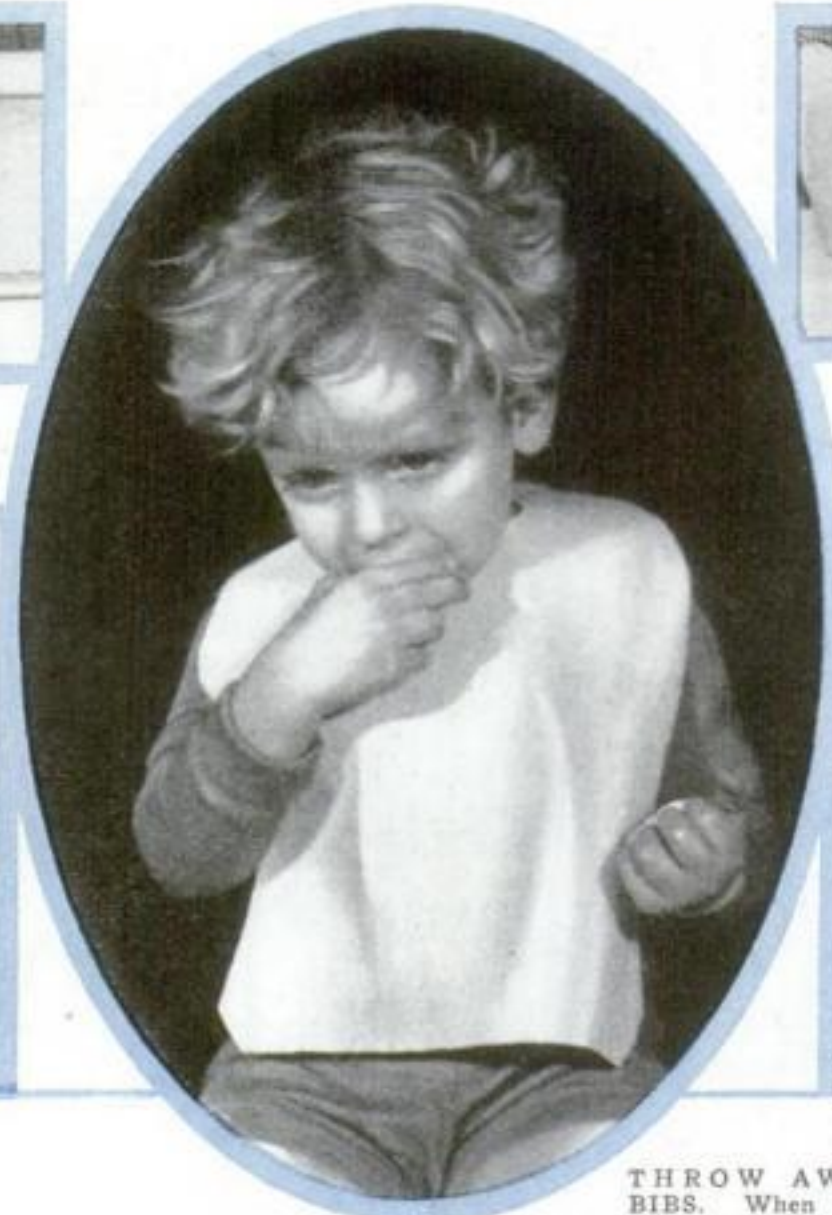
The dining room is small in comparison with the living room. It has doors to the kitchen and to a hallway leading into the rear of the house. There are French bay windows at one end and a large built-in coat closet on the opposite wall.

The kitchen is L-shaped. To the left of the dining room entrance in the kitchen is a built-in electric refrigerator, the built-in sections extending from the floor to the ceiling. Cane-faced, square cabinets are built around the upper and lower parts of the refrigerator division of the kitchen, to utilize space around the refrigerator.

AN ELECTRIC stove faces the refrigerator and in order to save space full length dishwashing and drying fixtures, composed of two sinks each having a separate drain, were placed along the outside of the long section of the L-shaped room. Compact porcelain water fixtures are used throughout.

Above the sinks are two small, half-length windows and above the drains are built-in cupboards that drop to the top of the sinks over the drains, to merge with small cabinets above the windows. Large cabinets, with *(Continued on page 138)*

CLEANS WINDOW SHADES. With this rubber pad dust is wiped away.



KEEPS THE SOAP HANDY. A perforated rubber sponge, with slit in it for soap, gives an instant lather.

OPEN IT WITH A JIMMY. No window can stick so tightly that it won't budge if this jimmy is used to pry it up. Its powerful leverage is applied to the window grip on first one side and then the other, forcing the most recalcitrant sash to yield.

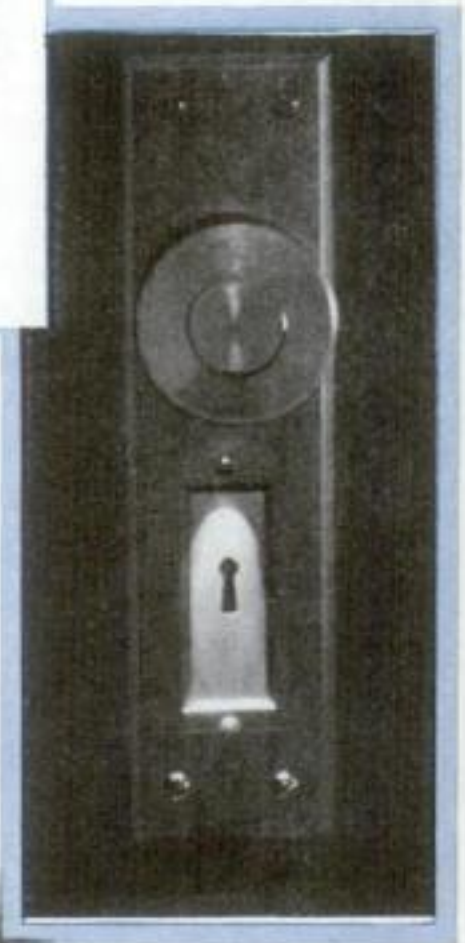
REMOVES JAR COVER. Here's a kitchen aid that expedites the task of opening sealed jars. Attached to the wall, teeth on its bottom edge raise cap in response to upward pull.

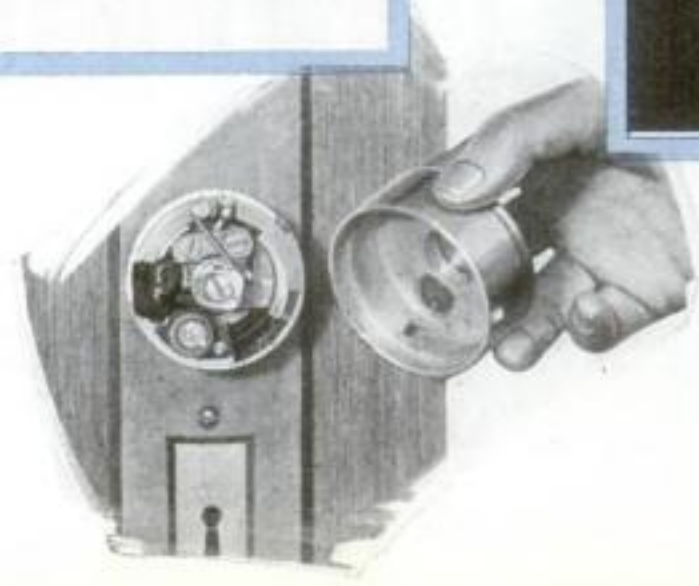
Inventions That Simplify Household Work

THROW AWAY BIBS. When the baby has done everything he can do to this bib, you needn't worry, because as it is made of paper, all you need do is simply throw it away.

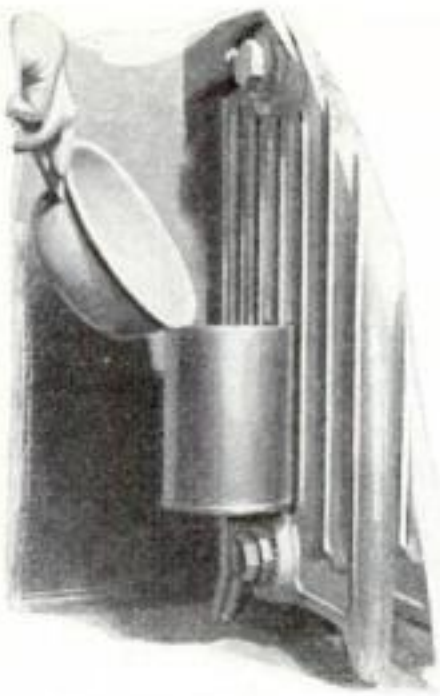
ADJUSTABLE STOPPER. The size of the bottle makes no difference—this stopper is capable of any required size. All that is necessary is to give the screweye at the top a turn, which expands the flexible cork for large necked bottles or contracts it for the small sizes. In removing it, three turns of the screw are all that's needed. The snugness of its fit insures the hermetical sealing of the bottle and the safety of the contents.

DON'T BURN YOURSELF. Dishes of hot food, ready for serving, are lifted and can be placed on the table by means of this convenient wire implement which has an ever-cool handle. Arms, clamping down around the plate, give a firm hold but are released instantly by a touch on a loop above the handle. Even full plates can be lifted.





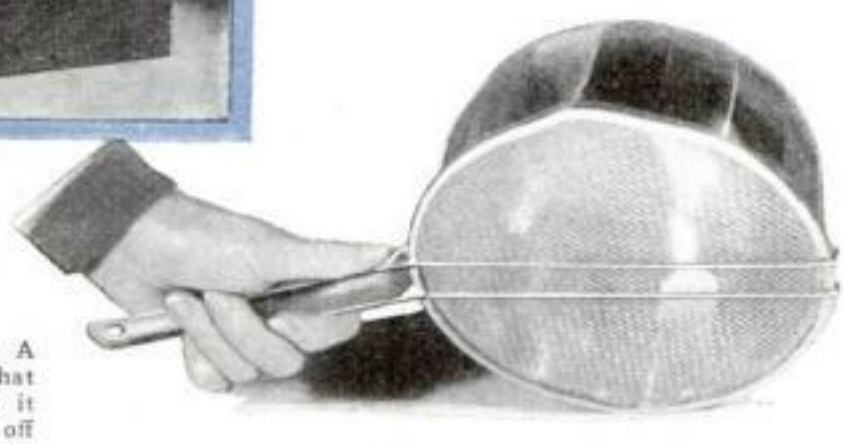
FINDS KEYHOLE FOR YOU. You will have no trouble unlocking the door late at night if this automatic light is attached to your door knob. A backward twist of the knob illuminates the keyhole as is seen above. The switch and lamp are in the knob, left. Bell battery supplies current for lamp.



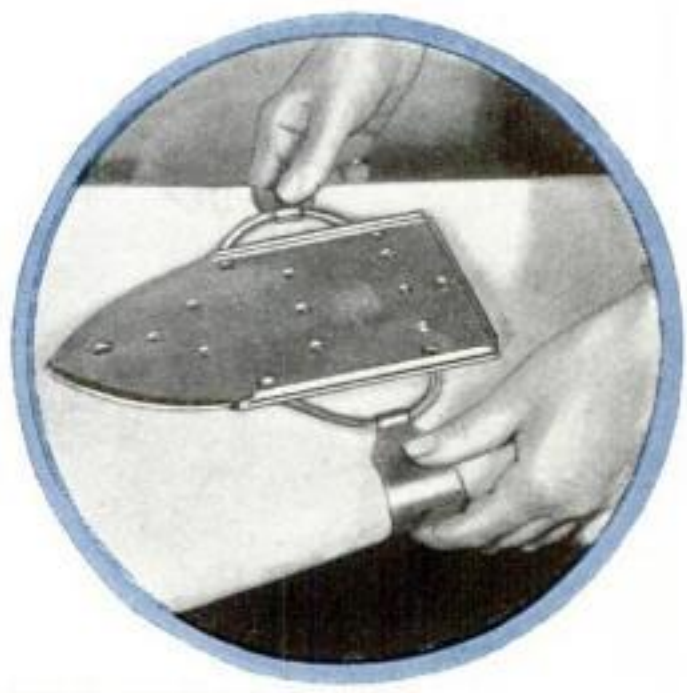
KEEPS AIR MOIST. A serviceable humidifier, designed to keep the air in your home comfortable, has a long blade that slides easily between the coils of the radiator.

PACK YOUR BRIDGE TABLE. Above is a standard bridge table that can be lowered instantly to a fifteen-inch height and used for serving coffee. It has the added advantage of being collapsible, in which form it fits into the case seen at left and is portable. The legs are of steel; the top of four hinged sections.

WASH AND COOK. A Portland, Ore., railroad man, with an eye to save space and time, has perfected this device which will wash dishes or clothes, mix bread, and steam food. A motor in the top operates the device.



DRAINER FITS PAN. A screen of wire mesh that fits over a pan makes it easy to drain the water off vegetables without danger of scalding the hands. The contents of the pan are held securely so that they cannot fall into the sink.



STOPS UGLY BURNS. This iron holder clamps to the ironing board and is held in place by springs. A sloped, pointed edge makes it possible to slide the iron upon it with little effort, while ridges keep the iron from falling off. Asbestos lined, the heat cannot burn through it.

MAKES RUGS STAY PUT. Accidents that occur as the result of slipping rugs are guarded against by the use of this liquid, right, which can be applied to the back of a rug in an hour. When dry the rug will not slip or curl up at the edges. It is also claimed that the application of the liquid will not mar the floor or the rug and neither does it prevent the lifting of the rug for cleaning.

POT HANDLE. Simplicity itself marks this lifter, at right, which is made of wire shaped to give a tight hold on a pot too warm to touch with the naked hands.

POPULAR SCIENCE MONTHLY

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The Value of an Idea

"THE chanciest business in the world," the head of the patent department of a great corporation told us recently, "is trying to estimate the present or future value of a new invention. Compared with this, predicting the future movements of the stock market is child's play and gypsy fortune telling is an exact science. Million-dollar ideas often turn out to be commercial 'flops,' while simple improvements revolutionize great industries. No matter how seemingly important any invention may be to an industry, its value may disappear overnight. Some new development may put the industry itself on the rocks.

"Suppose, for example, someone had invented a better tone arm for phonographs in 1920. A couple of years after that came radio broadcasting and the whole phonograph industry went down like a flat tire. And what would have been the value of an improved type of 'blind' typewriter just before the visible typewriting machine killed the sale of any kind of a blind model?

"Then, too, there is always the risk of an invention being made obsolete by a sudden change in human likes and dislikes—a style change.

"Once you never saw anything but wood wheels on automobiles. Then everybody went wire wheel crazy. After a while wire wheels lost their popularity and wood and disk types were the vogue. At present the style cycle seems to be shifting back to wire wheels. Style changes being vagaries of the human brain often are without rhyme, reason, or common sense. They cannot be predicted in advance."

HOWEVER, let the inventor take heart. Since all life is pretty much of a gamble anyhow, the inventor is no worse off than other people. If the inventor fails to profit because of a new development or a style change, he merely shares the common fate of the people in the industry affected.

It is almost as difficult to classify inventions as it is to estimate their value, but broadly speaking, an invention must be a new or improved way of doing an old job or a totally new way of doing a totally new job. As to which general type of invention is likely to bring the inventor the most money, it is impossible to decide. Sometimes a simple improvement will net its inventor many times the money obtained for a basically new idea that directly affects the lives of thousands of people.

The pages of POPULAR SCIENCE MONTHLY are filled with descriptions of both kinds of inventions. There is, for example, the latest news of the mercury boiler development on page 40. Here we certainly have a new and revolutionary idea. It is not simply an improved method of boiling water into steam. It is, in effect, a new way to get power out of coal. Then on page 28 there is a story of the autogiro. This queer flying machine is radically different from the ordinary airplane. And it may, in the end, shove the ordinary plane into the discard altogether.

ON the other hand, the various developments, some of them inventions, which have boosted the speed of an airplane from forty or fifty miles an hour to within hailing distance of four hundred miles an hour are, in the last analysis, merely more of the same thing, like a second helping of turkey.

In theory at least, it should be easier to determine the value of an invention that will make an automobile go faster or a machine operate more efficiently than to tell what a radically new invention is worth now or will be worth in the future. The prediction in the first case can be built on experience with the unimproved device. In the second case the possible ramifications of a new invention are quite unpredictable.

THE phonograph industry, which the industrial patent expert cited, also furnishes an example of the unexpected use of a new invention. Groggy and almost ready to go down for the count in the battle with radio, the phonograph was brought back to healthy life by the unexpected use of an invention produced by telephone engineers for quite another purpose. Their invention of the exponential type horn gave the phonograph a new and far better tone. And the further application of scientific sound principles developed in telephone engineering laboratories, combined with developments forced by the growth of radio, resulted in the "talkies." Here, too, scientific invention and development gave a new lease of life to an industry in the grip of a serious depression—which was the state of the silent films when science gave them a voice.

If you wish to do a little scientific fortune telling on your own account, consider television and try to figure out when, if ever, we may expect it in a practical form.

Theoretically, television is possible now if cost is not to be considered. But so far engineers have run into a stalemate in attempting to convert the known theory into a practical system. Here, at least, is one branch where an improvement on known apparatus is not likely to amount to much unless a totally new invention allows the whole problem to be attacked from a new angle.

APPARENTLY the essential difference between a successful inventor and the threadbare gentleman with a long string of worthless patents in his name lies in the manner each man goes at his job.

The successful inventor may become completely absorbed in his idea, but he never loses his hard-headed common sense. He masters the fundamentals of the subject with which his idea is concerned and he saves time and wasted effort by finding out what others have done before him. In spite of his enthusiasm, he tries to view his work with the coldly critical eye of the ordinary man, knowing that it is the verdict of the average man that will make or break his invention.

The unsuccessful chap becomes so wrapped up in his idea that he loses all sense of proportion. The value of his idea becomes exaggerated in his own mind and he may, in the end, fly off at a tangent and invent something of no possible use to anybody.

If inventing is the "chanciest" business in the world, then the way to make a go of it is to apply to it every ounce of brains, common sense, and vision you can scrape together.

Blames It on the Moon

SCIENCE continues to shatter our pet illusions. Clockmakers believed that if you could get a clock pendulum that wouldn't expand or contract with temperature changes and you could put the pendulum in a vacuum chamber and drive it with a frictionless mechanism, the clock would tell accurate time.

Now along comes Dr. E. W. Brown, of Yale University, president of the American Astronomical Society, and proves that if you had such a clock it couldn't keep accurate time anyhow. He has found that the pendulum of a clock is pulled first one way and then the other by the attraction of the moon.

However, as he says that the error thus caused is only about fifteen hundred-thousandths of a second in twelve hours, we don't think it would serve as a good alibi for being late to work!

Here the primary and secondary coils of an intermediate frequency transformer are under examination. These are the kind that are used in the superheterodyne circuit.

Why Your Radio Fails at Knife-Edge Tuning

By ALFRED P. LANE

JUST why should the broadcasting from station XYZ be heard only when you have the dial set at a given number? Why don't the other stations come in at the same point? And why do the near-by local stations spread over many degrees on the dial of a set that is guaranteed to tune sharply?

Many a radio set owner has wasted hours of his own and the service man's time just because he didn't know the answer to these questions. Many a radio set has been unjustly condemned and its owner has become thoroughly dissatisfied for the same reason.

The difficulty arises in a general misunderstanding of what is and what is not possible in radio circuit tuning. The terms "hair-line selectivity," and "knife-edge tuning" have no real meaning and even "ten-kilocycle separation" is possible only under very special conditions.

In order to understand what degree of sharpness actually is possible in the tuning of a radio receiver, it is necessary to form a mental picture of what happens in the tuning circuits.

ATTEMPTS have been made to explain what goes on in a radio tuning circuit by comparison with a tuning fork, which can be caused to vibrate only by air waves of the proper pitch.

However, the comparison falls down when the radio fan tries to figure out just how a tuning fork resembles the coil and condenser in the radio circuit, there being no points of physical similarity.

In any electrical circuit where alternating current is flowing, the current flow is retarded both by the electrical resistance of the wire and the electromagnetic reaction of the circuit. When current flows through a wire it sets up a magnetic field around the wire and this field acts to resist any change in the direction or intensity of the current flow. This electromagnetic effect is, of course, much more pronounced if the wire is arranged in the form of a coil because the magnetic field is much more concentrated.

SINCE the magnetic interference with the flow of current acts only when the current flow is changing, it naturally follows that the interference increases in proportion as the frequency of alternation is increased.

By itself the tuning coil in a radio tuning circuit would therefore act merely to cut down the flow of current. At radio frequencies which, in the broadcast band, run from 1,500,000 down to 550,000 cycles per second, this interference of the coil with the flow of current is quite pronounced.

Introducing the tuning condenser into the circuit changes the situation because the condenser acts in the opposite manner to a tuning coil. The more rapid the frequency of the current, the less resistance the condenser offers to the flow of the current. By a proper choice of capacity for the condenser it is possible to get a combination of coil and condenser that will present only a negligible resistance to the flow of current at some one frequency. As the frequency is changed, either up or down, the resistance of the coil and condenser combination becomes greater.

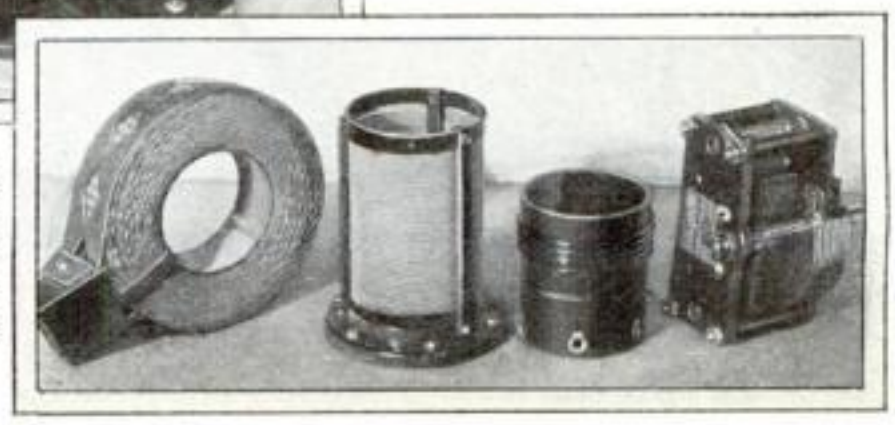
IF, FOR example, you set up a coil and condenser that would allow a 1,000-kilocycle frequency to flow through practically unimpeded, current having a frequency of 1,010 kilocycles would also flow through in slightly diminished quantity. The greater the difference between the frequency of the incoming current and 1,000 kilocycles, the greater would be the resistance it would encounter from the coil and condenser.

You can see the difference, therefore, between a tuning fork and a coil and condenser tuning circuit. The tuning fork won't start to vibrate at all unless the air vibration is precisely the right pitch, whereas the tuning coil and condenser merely shows less resistance to one frequency.

Your antenna feeds into your radio set a mixed assortment of frequencies covering the whole

(Continued on page 139)

Note the adjusting screws one firm uses to be sure tuned stages are synchronized.



Any of the three coils at the right could be used with the variable condenser to "tune" a radio wave. The one at the right would cover a band lower than broadcasting.

Be Your Own *Expert* on *Radio* Troubles

By JOHN CARR

Fig. 2. Don't hurry to call the service man. Maybe the station is not broadcasting.

MODERN electric radio receivers, although reliable, occasionally go wrong as do any delicate and elaborate pieces of machinery. And in most cases the owner can easily remedy the trouble in a minute or two without having to call in a radio service man.

Just as the average motorist knows what to do when the gasoline tank is empty or a tire has gone flat, so the radio listener can learn to diagnose and repair common and simple radio troubles.

The mechanism of a radio receiver consists of an intricate combination of wire coils, condensers, chokes, resistances, and so on. Most of this apparatus is stationary. Unlike the automobile in which wear on moving parts is the principal source of trouble and the ultimate cause for scrapping the vehicle, mechanical motion plays a small part in the life of a radio set. Difficulty with the rotating condenser plates is rare and trouble with a volume control, tone control, or switch is unlikely.

When your radio set ceases to operate as it should, you can be reasonably sure that the trouble is of an electrical nature either inside or outside the set. Since the set itself is built as a unit and carefully inspected in the factory by experts, the most likely place is outside the set.

IF YOU discover that your set will not bring in the station you want, start at the beginning and make sure that the broadcasting station actually is transmitting. Radio service men regularly respond to calls to fix sets when an SOS has ended the broadcasting or an accident has put a station off the air.

The easiest way to check these possibilities is to tune around in search of some other station which will indicate that the set is functioning. The reception of the usual amount of static when the volume control is turned up is another indicator.

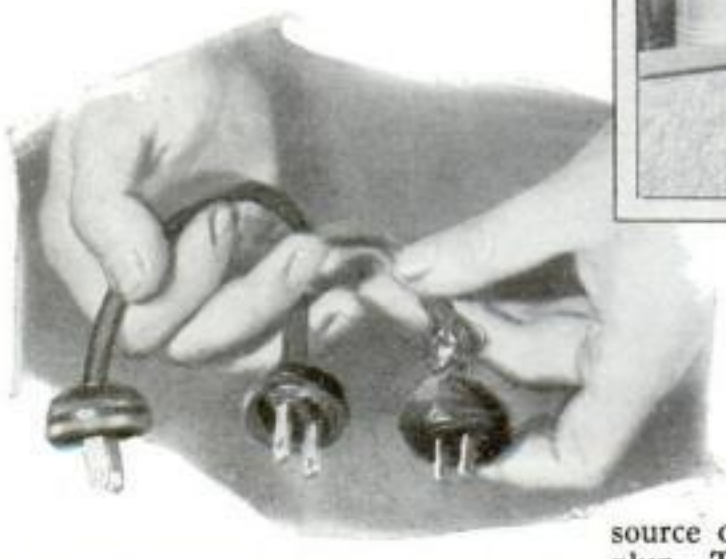


Fig. 1. Examine plugs to be sure set is getting power. Here are two bad and one good plug.

This test also will tell you whether the antenna or ground is disconnected, a common trouble, because the modern shielded set always will bring in a lot of static when operated "wide open" on an antenna of even moderate length.

The first step, then, when the set fails to function, is to make sure that the broadcasting is going on and that the antenna and ground are connected and in proper condition.

Next see whether the set is being supplied with electric power. In the days of battery operated sets this was quite a job because many things could happen to a battery supply system. With an electric set, though, you know that the current supply in the house wires is adequate if the lights are burning as usual. However, you will want to know whether the current actually is flowing into the set. Figure 1 shows a likely source of trouble—a broken or defective plug. The one shown at the left is in perfect shape. The one in the middle has been dropped so violently that the shell was fractured and the wire connection to the prong loosened. The plug at the right has been stepped on and is held together with a piece of tire tape. In addition the wire is badly frayed. This plug functioned for a while but stopped carrying current in the middle of an exciting football broadcast.

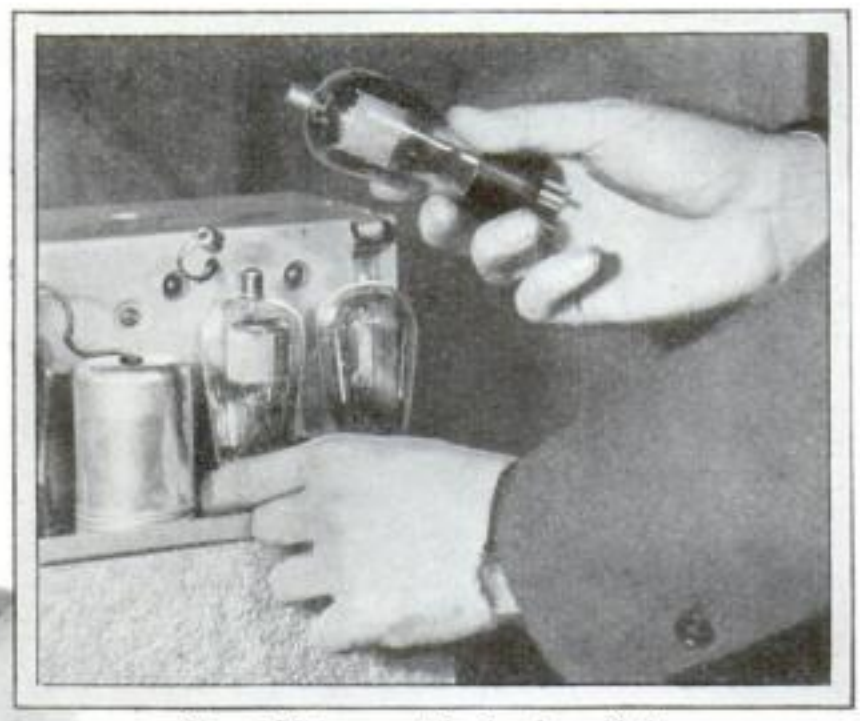


Fig. 3. Put a new tube in place of the one you believe may be bad and so locate the trouble.

THE operation of any radio set is dependent on the vacuum tubes. Ordinarily, only two things can happen to them, one of which is bound, in the end, to terminate the life of the tube: It can burn out or it can become exhausted.

A burned-out tube can be found by inspection, as a tube that no longer glows is done for. An exhausted tube, on the other hand, glows as usual, but the chemicals on the cathode no longer produce the flow of electrons on which the operation of the tube depends.

Complete tube failure is easily located, but tube failure through exhaustion may produce a number of vague troubles, difficult to locate, because exhaustion of the chemical elements may be only partial.

Among the list of vague troubles that may be traced to partial tube exhaustion are weak signals, fading, tone distortion, spotty noises, microphonic effects, and excessively long time required for the set to get into operation after the current is turned on.

Generally the modern set employs four different types of vacuum tubes. The type 224 screen grid heater tube is used for radio-frequency amplification, the type 227 general purpose heater tube is used as a detector and first-stage audio amplifier, the type 245 power tube operates the last or

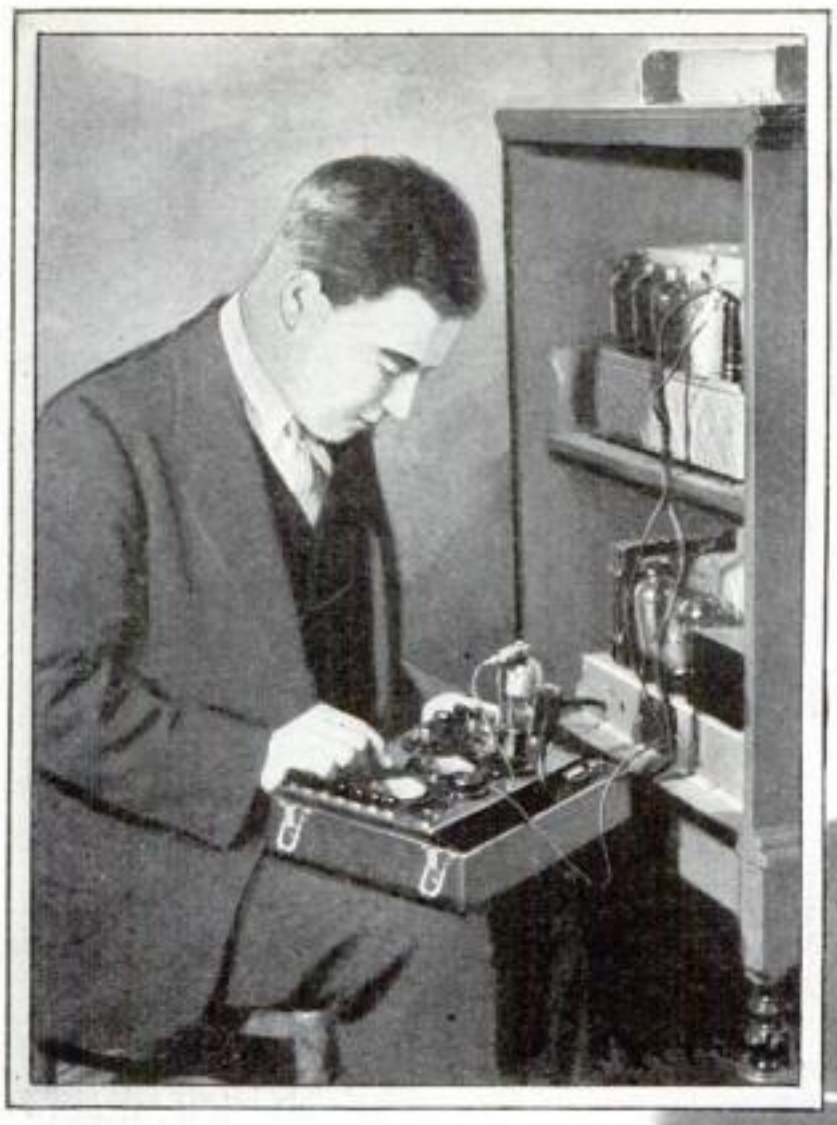


Fig. 4. The service man may be a whiz at radio but if his equipment is bad he can't help much.

power stage of audio amplification, and the type 280 full wave rectifier tube takes care of turning the high voltage alternating current into direct current to operate the high voltage circuits of the receiver. In many cases, it also energizes the field of the dynamic speaker.

PARTIAL failure of a 224 tube will reduce the radio-frequency amplification and weaken the signals. Distortion also may be caused. If the electron flow drops below a certain point on the tube in the last radio-frequency stage, it becomes overloaded on strong signals and passes only the peaks of the radio waves. Speech and music, under such conditions, take on a ragged and disagreeably harsh tone.

Partial exhaustion of the 227 tube in either the detector or first audio stage, or of the 245 tube in the last stage, results in poor power handling ability. In other words the distortion point is quickly reached when you turn the volume control to get more than weak volume.

The heater tubes, either 224 or 227, can be responsible for excessive time between turning on the current and the first sound of broadcasting. Frequently, when these tubes are approaching exhaustion, all sorts of queer noises will be produced before the receiver goes into action. This is particularly true if only one of the screen grid type 224 tubes is going bad. If the 227 detector tube is failing, there usually is a pronounced hum from the speaker during the heating up period. On the other hand, if the first audio 227 tube is weakening, there may be almost total silence during the heating period.

Most radio owners have no testing equipment and therefore to determine which tube is at fault they must take the tubes to a dealer for testing, or find the bad one by a process of elimination. In taking tubes to a dealer be sure to pick one who is reliable. Otherwise you are quite likely to be told the tubes are bad whether they are or not just so he can sell you new ones.

In the process of elimination you substitute a new tube for the doubtful one in the set. You should have on hand one new tube of each kind used in the receiver. When the receiver begins to "act up," start with the first 224 and, the power being off, of course, substitute your new tube as shown in Fig. 3. Try the set again, and if there is no apparent change or improvement you are safe in assuming the 224 is still on the job. Shut off the set again, put the old tube back in the socket, and substitute the spare for the second tube and so on. If there is a change or improvement in reception results leave the new tube in the socket, throw away the old one, and get another new tube for further testing.

Fig. 5. The flexible lead on the screen grid tube may be chafed. Change these tubes carefully.

BY THIS method you can bring your set up to full operating efficiency at the minimum expense. Remember that while radio vacuum tubes may have a rated working life of 1,000 hours, that is, a shade less than three hours a day for a full year, the actual life in hours is not a fixed quantity like so many dollars or doughnuts.

Tubes may give out within a month or less or they may last for several thousand hours.

The screen grid tube, because of the necessity for a flexible top connection, has led to one new type of trouble. The flexible lead may become chafed through at the point where it passes through the shielding if it is roughly handled. See Fig. 5. Be careful in changing screen grid tubes.

If following out these suggestions does not put the set in good operating condition, call in the radio service man, making sure you get one who is properly equipped. If he shows up at your house with an old bag full of miscellaneous pliers, screw drivers, and odd parts, you can be sure that no matter how much of a "whiz" he is at radio, he isn't equipped to determine, quickly and accurately, what is wrong with your radio receiver.

Figure 4 shows a service man testing the functioning of a radio receiver with the aid of a modern "set analyzer." The cost of such an instrument is from $75 to $150 or more and it is, consequently, hardly the type of equipment the individual radio set owner would be likely to buy. Such an instrument is, however, a virtual necessity to the professional radio service man. It enables him to determine quickly and accurately just what is going on in every circuit of the set and also tells him at a glance the condition of each tube.

While many radio dealers sell radio sets with a guarantee of free service for some stipulated length of time, the common practice is to make a definite charge for all service calls made after the time limit expires. Calls are charged for either at so much a call or on a time basis. Therefore, it costs as much to have the service man come around and put the loose antenna wire back on the binding post as it does to have him locate some deep-seated trouble.

It may be well to point out that "tinkeritis" is just as fatal to good radio reception as it is to satisfactory motoring. Know your own limitations. If you are not skilled in radio do not tinker with the insides of the set. Make the simple tests and do the outside jobs listed. If your set still refuses to operate, call the service man.

BEFORE YOU CALL THE SERVICE MAN

1—Make sure that the antenna is connected.

2—Check the ground connection; see that it is tight.

3—Look over the condition of the power plug.

4—Inspect tubes to see that all glow as usual.

5—Determine condition of tubes by substitution.

"Trouble is," Gus explained, "the battery gets pretty low because you don't drive enough in the daytime."

Starting Tricks for Cold Weather

Gus Tells You Secrets about Batteries, Hot Water, and Gadgets to Keep Your Car Ready for Quick Use

By MARTIN BUNN

JOHN WHIPTON, who lived out on the edge of town, was a steady patron of the Model Garage. He came regularly to have Gus Wilson, veteran auto mechanic and half owner of the establishment, inspect the car and check its condition.

Whipton was a fussy customer. He wanted things to be just right. And in spite of the fact that he had an absorbing interest in mechanical matters, he was, himself, possessed of no skill with tools.

Gus was not surprised when Joe Clark, his partner, came out of the office one winter morning to announce that Whipton was calling for help.

Whipton's appearance as he swung open his garage door after Gus had backed the service car down the driveway graphically suggested the trouble. He was coatless. Beads of perspiration stood on his forehead and a starting crank dangled from his hand.

"You're a fine auto mechanic, I don't think!" Whipton exclaimed. "Only two weeks ago I had the car at your place and you said it was in perfect condition. Now look at the darn thing—won't even start with the crank!"

"Where were you last night and the night before?" Gus asked.

"What's that got to do with it?" snapped Whipton. "Last night we drove over to the other side of town to visit friends and night before that was lodge night."

"Hum-m!" said Gus. "I'll bet you left the car standing with the headlights going, didn't you?"

"Sure I did," Whipton admitted. "But that shouldn't run the battery down."

"It wouldn't if you'd been doing any amount of driving in the daytime," Gus explained. "Trouble is, the battery gets pretty low because you don't drive enough in the daytime. Then the extra load of standing two nights brings it down to the point where it hasn't any snap left."

"It had snap enough to turn over the motor for quite a while," Whipton protested. "After it wouldn't turn any more I got out the crank. I spun it till I thought it would start playing phonograph music, and still nothing happened. What ought I to have done?"

"MAYBE if you'd cranked it by hand after the first couple of shots at the starter, it would have started. As it is," said Gus, "you ran the battery down so far with the starter you haven't enough juice to make a spark hot enough to start a cold motor. Simplest thing now is to try the old reliable hot water method. Bring out a pail of real hot water and we'll get going."

Whipton came out with a pail of steaming hot water and after Gus had slowly poured it over the intake manifold, the motor started almost with the first effort.

"I should have had sense enough to think of that," Whipton grumbled disgustedly. "I'll chalk it on the wall so I won't forget it next time."

"What would you do if you couldn't get any hot water?" Gus inquired with a smile.

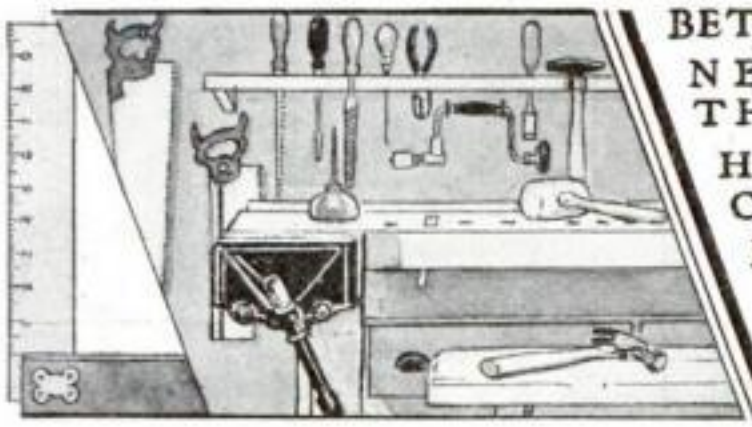
Whipton thought a moment. "I'll bite," he finally said. "What would I do?"

"Well," said Gus, "there's a lot of ways to get a cold motor started. Hot water is the simplest. But if you haven't any and there's a drug store handy, buy yourself a small can of ether. Pour a little in the air intake of the *(Continued on page 145)*

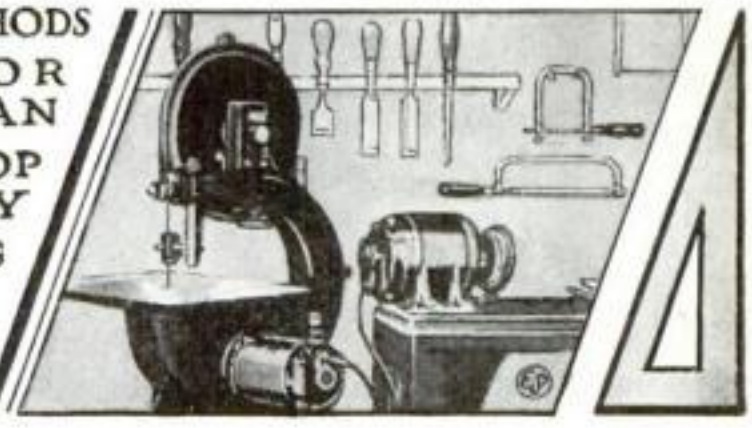
Gus Says:

WHEN you buy new tires, put 'em on the front wheels if you have any regard for your own safety. Most tires end their lives in a blowout, which is more dangerous on a front wheel. And the faster you drive the more chance there is that a front tire blowout will send you off the road or into a car coming the other way.

THE HOME WORKSHOP



BETTER SHOP METHODS
NEW IDEAS FOR THE HANDY MAN
HOME WORKSHOP CHEMISTRY
MODEL MAKING
BLUEPRINTS
SHIPSHAPE HOME



Building an *Enterprise* Model

Here's your chance to work from the original drawings of the world's greatest racing yacht

By W. STARLING BURGESS

Designer of the America's Cup Defender "Enterprise"

AS I HAVE received countless requests for plans from which to construct a model of *Enterprise,* it gives me great pleasure that, with the consent of Mr. Vanderbilt, I am able to place simplified reproductions of the original drawings before the many ship model makers who read POPULAR SCIENCE MONTHLY.

In building a model, it will be necessary first to decide upon a convenient reduction scale. Five such scales and the corresponding dimensions for the completed model are given in the table at the top of the next page. The hull can be built by the common "bread and butter" method of lifts, the sizes of these lifts being obtained from the half-breadth plan. Cut away the extra stock on the glued-up hull carefully, testing the shape, from time to time, with cardboard templates made from the lines given in the body plan. In studying the half-breadth and body plans, you will note that some of the original water lines and station points have been omitted. This was done for clearness.

For a sailing model, a deep fin keel having a large lead bulb on the bottom will be necessary. The weight of this can be obtained by experimenting with the completed hull, placing sufficient weight on the hull to sink it down in the water to the load water line.

While the drawings show the sails and rigging as they appeared on *Enterprise,* they can be altered easily to meet the requirements of a sailing model. For instance, if a jib, topsail, and staysail are used, it will be best if they are made narrower so

Enterprise—a yacht that has caught the fancy of model makers the world over.

There's a story back of this article. The editor knew that many readers would be eager to build a model of *Enterprise,* but yachting men to whom he turned for information were amused at the idea of publishing the authentic lines of the yacht so soon after her victory. It wasn't done—at least, it hadn't been in all the history of the Cup Races. So the editor went directly to the designer himself with a plea on behalf of model makers. And, precedent or no precedent, Mr. Burgess was willing to write the article himself.

that each sail will swing free of the luff side of the sail directly aft of it when a tack is being made. A boom also should be added at the foot of each head sail. Of course, as is the practice on many sailing models, a single jib may be used.

Aside from her metal mast, probably the most radical and universally talked of feature on *Enterprise* was her triangular section, sliding-foot boom. Although it would probably be difficult to incorporate this sliding arrangement on a sailing model, the triangular section can be retained.

As is customary on a sailing model, the main sheet should be rigged to the udder in order to effect a semiautomatic control of both rudder and mainsail and an adjustable and convenient means for belaying the sheets should be supplied.

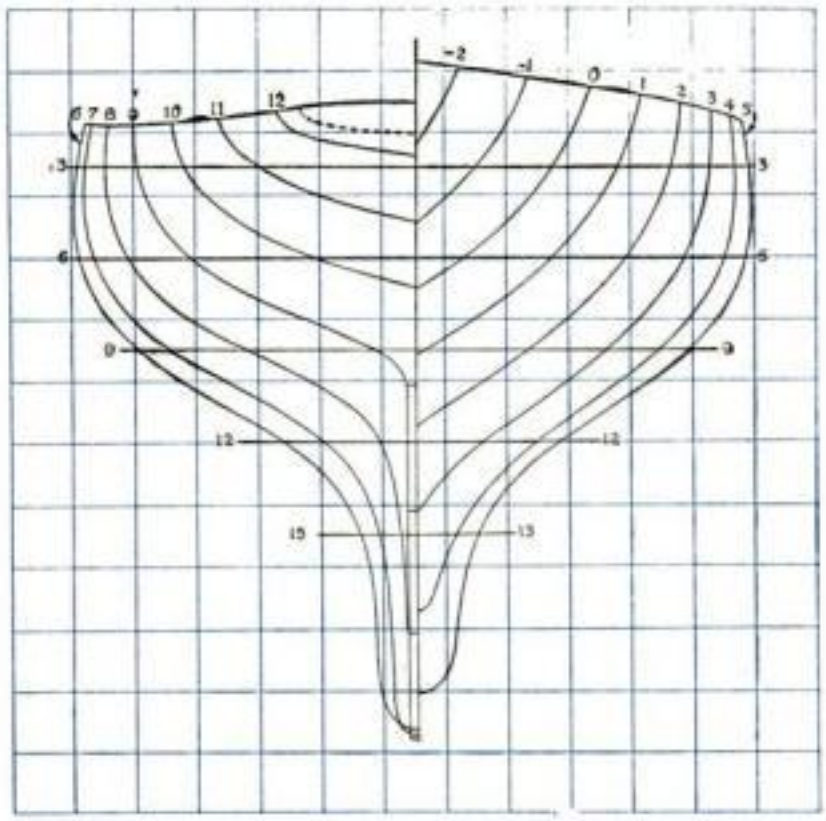
As to the deck fittings, these are shown in the drawings. However, on a sailing model it may be well to omit many of these.

Enterprise is painted white above the water line and left unpainted below. Since the hull was fabricated from bronze plates, this effect can be simulated on a model by painting the hull white above the water line and bronze below. *Enterprise* has no boot topping. The spars and the boom are white.

In order to make the model more realistic, scribe lines along the deck for the planking.

As an additional courtesy, Mr. Burgess will have blueprints made up from his original drawings for those who are willing to defray the cost, which he estimates at $10 (two blueprints 30 by 60 in. and one 16 by 21 in.).

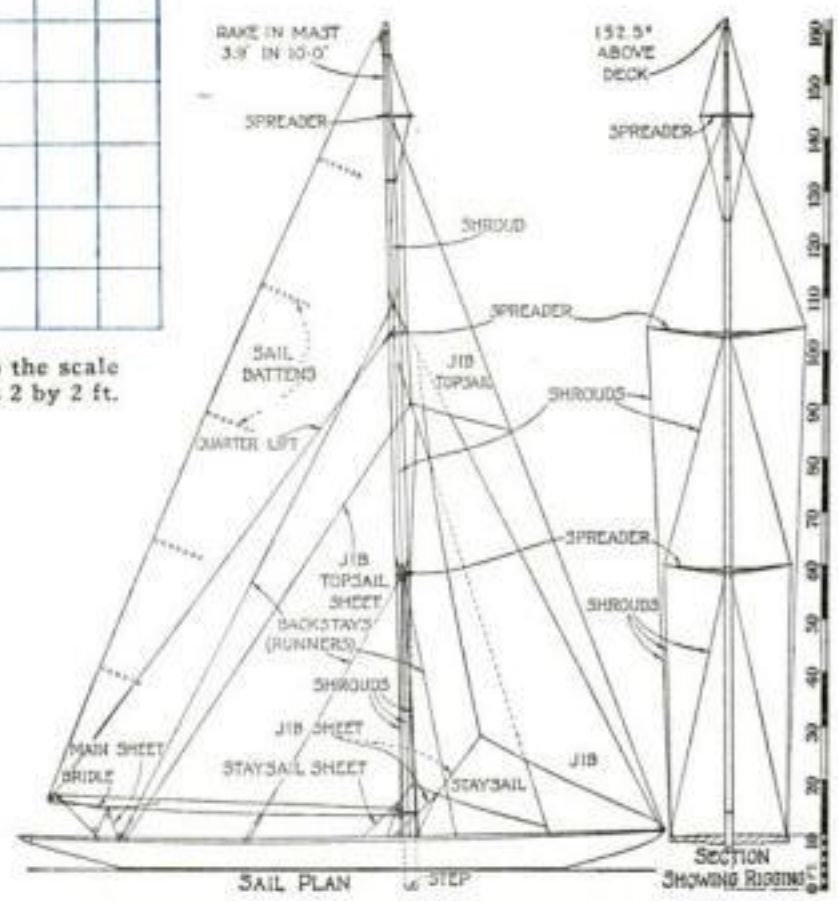
Detailed instructions on model yacht building will be found in the book "Build a Winning Model Yacht" by Thomas Moore. See also the "Home Workshop Manual."



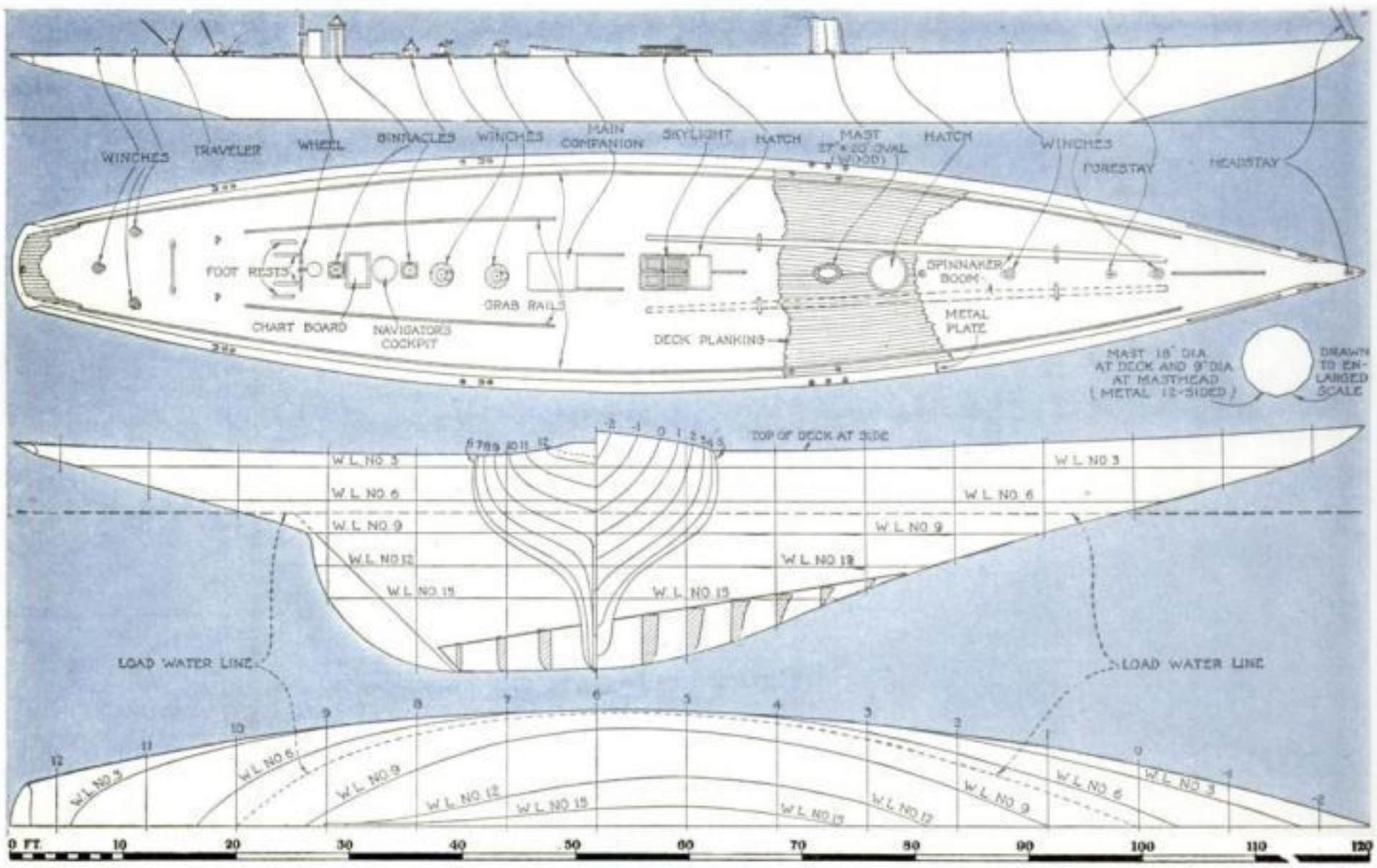
The body plan arranged for easy enlargement to the scale you wish to use. Each colored square represents 2 by 2 ft.

Chart to Aid in Choosing a Scale for Your Model

Scale in inches per foot	Overall length in inches	L.W.L. length in inches	L.W.L. extreme beam in inches	Approx. height of mast in inches
1/8	15	10	2 5/8	19 1/16
1/4	30	20	5 1/4	38 1/8
3/8	45	30	7 7/8	57 3/16
1/2	60	40	10 1/2	76 1/4
5/8	75	50	13 1/8	95 5/16



Sail plan of *Enterprise* with scale in feet. From this you can make a full size layout to the scale of your own model.



Drawings of the hull traced in somewhat simplified form from the designer's original plans, with a scale in feet. For convenient reference, the body plan (given larger at top of the page) has been repeated.

Stagecoach Cut in Sheet Aluminum Ornaments This Radio Lamp

The stagecoach silhouette is mounted in front of an illuminated sheet of ground glass.

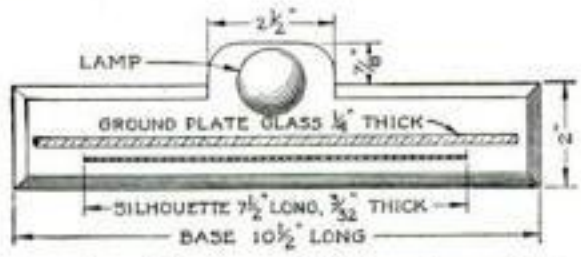
THE stagecoach model silhouette lamp illustrated is an original and most attractive ornament for use on a radio cabinet, mantel, or console table.

The silhouette, which is 7½ in. long, was cut from 3/32 in. thick aluminum. The design was taken from a previous article by J. W. Bollinger on weather vanes (P. S. M., Nov. '30, p. 94). I made a photographic copy of the required size from the drawing in the magazine and glued it on the aluminum. After all the cutting had been finished, the paper was soaked off in hot water, and the edges of the metal were smoothed with a file.

The base block is 10½ in. long. The glass for the lamp, which was ground to make it nontransparent, is ¼-in. plate with a ¼-in. bevel. Of course, the glass could be any shape or size desired. Both glass and silhouette are set in slots in the base.

When completed, the wooden stand and the silhouette were given three or four coats of copper bronze. A small golden glow bulb with an intermediate size base furnishes the light.—JAMES W. BLAIR.

Copies of the November, 1930, issue can be obtained from the Subscription Department for twenty-five cents.



Top view of the lamp with dimensions, which, however, are offered merely as a suggestion.

How to Make a Handy Pipe Rack for Your Reading Table

MOST pipe racks are designed to hang on the wall, but here is one that will stand on the table near your chair, where you can reach it easily without having to get up.

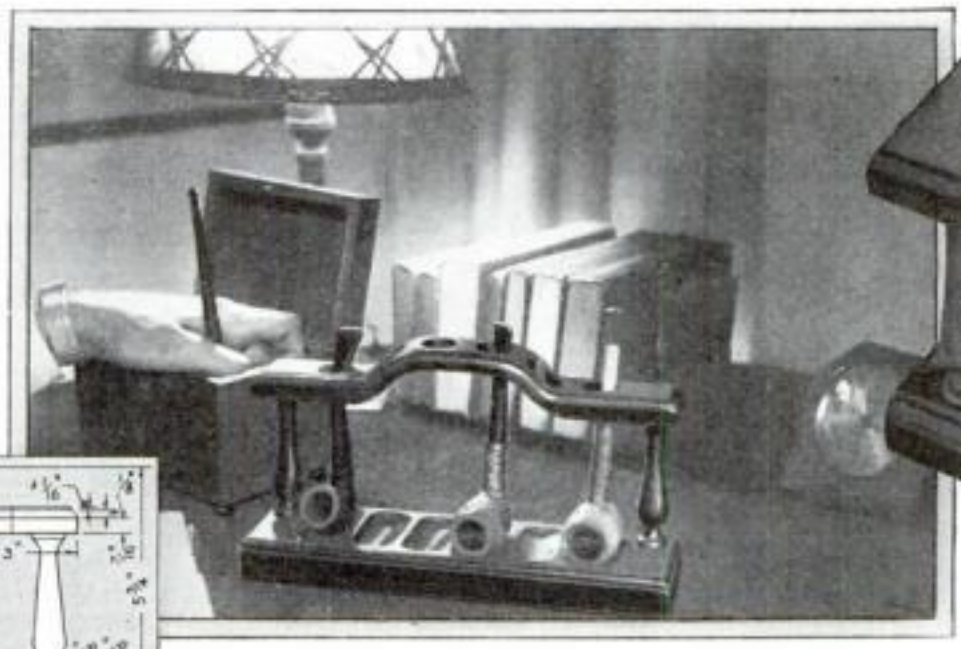
While any wood may be used, a fine cabinet hardwood is to be preferred. A piece 1½ by 1¾ by 10½ in. is required for the top of the rack. Make a template to the form of the side view, as shown, and trace it on the stock. With a fret or coping saw, cut out the form. Then locate the centers of the six holes and bore them with a ⅞-in. bit. The small edge molding is now worked out carefully by hand.

The two small standards are next turned and sandpapered while still in the lathe. If a lathe is not available, tapered octagonal standards can be made by hand with a plane.

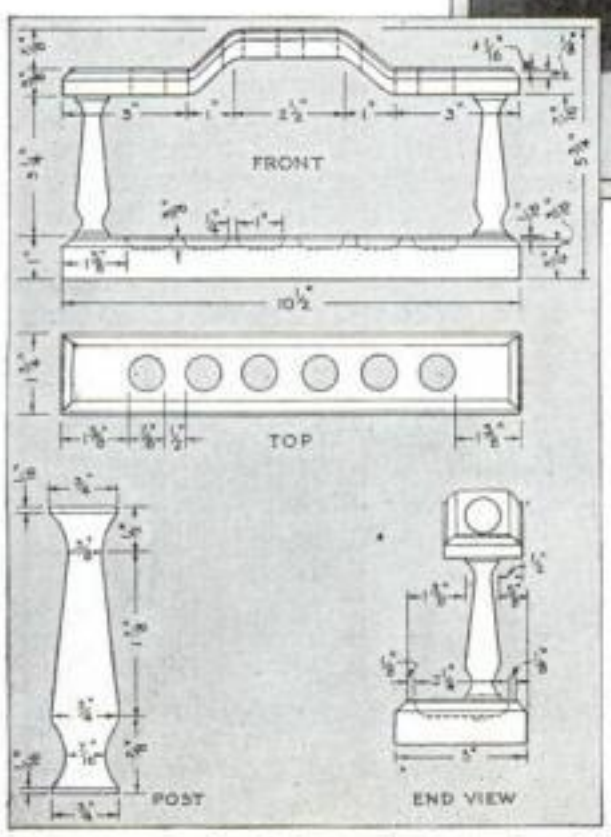
The platform is constructed from a 1 by 3 by 10½ in. piece. On the top surface an edge molding like that on the top is repeated on all four sides. The six small recesses for the pipe bowls are cut with a gouge, the cuts being made from each side toward the center to prevent splitting. In sanding this piece, take care that the outline of the trays, as well as the edging, is kept sharp.

The rack is assembled with 1½-in. brads driven through the bottom into the standards and 1-in. brads driven through the top. As hot carpenter's glue or a high-grade liquid glue is used in making all four joints, one brad through each will be found sufficient. Sink the heads into the wood with a nail set; and when the glue has hardened, remove all excess, and sandpaper carefully. Fill the nail holes with a prepared wood composition.

The finish depends upon the wood used. For a good cabinet wood, it is sufficient to use a coat of stain, an application of wood filler if the grain is open, and one or two coats of varnish. Glue a piece of green felt on the bottom to prevent it from scratching the table top.—E. T. H.



The advantage of a table-type pipe rack is that it can be kept within easy reach of your favorite chair.



Front, top, and end views of the rack, and one of the turnings drawn to a larger scale.

For novelty you'll find it hard to match this

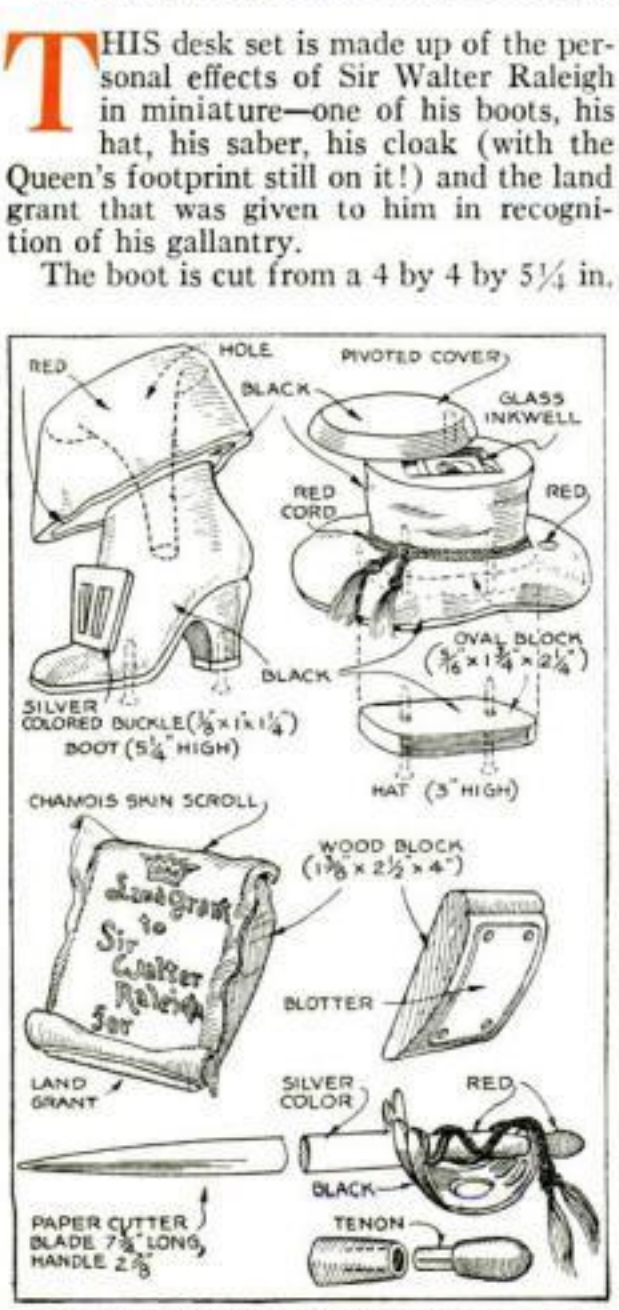
Sir Walter Raleigh Desk Set

By CHARLES HERBERT ALDER

A novel and attractively colorful desk set which includes an inkwell, pen and pencil holder, rocker blotter, letter opener, and large desk blotter.

THIS desk set is made up of the personal effects of Sir Walter Raleigh in miniature—one of his boots, his hat, his saber, his cloak (with the Queen's footprint still on it!) and the land grant that was given to him in recognition of his gallantry.

The boot is cut from a 4 by 4 by 5¼ in. block of soft white pine, spruce, or redwood, or from a hardwood if you choose. On the block, sketch the side, front, top, and bottom views of the boot and then drill a ¾-in. diameter hole to within ½ in. of the bottom. Next, remove as much of the waste stock as possible with a band saw or hand saw and then carve the boot to shape with either a knife or chisels.



Sketches showing the construction of the boot, hat, land-grant blotter, and saber.

The hat is made of two pieces as shown. Cut the crown or main part from a piece of 3 by 3 by 2¼ in. stock, and the brim from white pine ¾ or 1 in. thick. When the crown has been carved to shape, cut off the top, and drill and chisel a hole to take the glass inkwell. The top is pivoted on a short nail driven into the top of the lower part of the crown. The wrinkles on the brim and crown can be made with a round file.

Nail or screw the crown to the brim and then drill a slanting hole for the quill in one side of the brim. This plume or quill can be obtained in the ten-cent store.

The base is a board 6¾ by 14 in. with rounded corners and beveled edges. Drill a hole in the baseboard directly under the hole for the plume in the brim and in this insert a short cork.

The feet on the base, which are made from the round ends of four clothespins, are glued in holes in the corners. Burn or write in India ink the inscription "Ye personal effects of Sir Walter Raleigh"; this can go either on the beveled edge or on the top. If the brim of the hat shades the inscription, raise the hat on a small oval block about ¼ in. thick. Stain and varnish the top and lacquer the edges black and feet red before mounting the boot and hat.

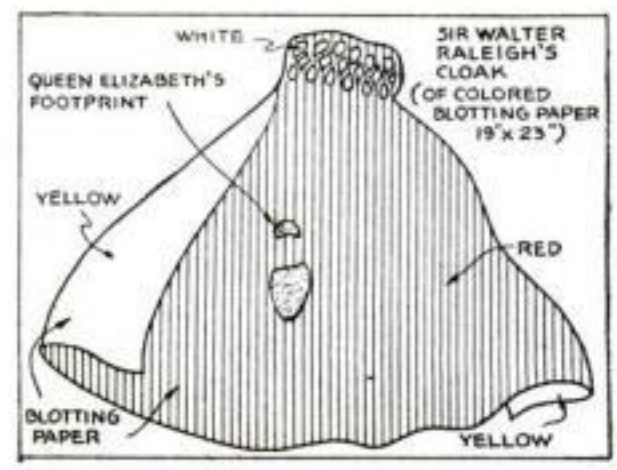
The saber is made of wood. The guard can be of sheet metal; I used an aluminum cookie mold from the ten-cent store.

Make the rocker-shaped blotter holder from wood and lacquer it black. On this is mounted the land-grant scroll, which is made from chamois skin and glued to the block. Burn a suitable inscription on the scroll and give the skin a coat of shellac, or shellac it first and then do the writing with an indelible pencil. The blotter is held in place with thumb tacks.

The boot and hat form the inkwell and pencil holder stand, the saber is the letter opener, and the land grant covers the rocker blotter.

The last item is the desk blotter which resembles the cloak. This is made by cutting pieces of colored blotting paper as shown and gluing or pasting them together. The Queen's footprint is then drawn on the cloak and colored with crayon.

For the tassels on the hat and saber I used the silk cords from bridge tally cards.



How the colored blotting paper is glued together to form Sir Walter's famous cloak.

Folding Leather Coin Purse

How to make a novel change pocketbook from a single piece of "tooling calfskin"

By F. CLARKE HUGHES

BECAUSE of the trick way in which it folds shut, a coin purse like that illustrated has a greater appeal for most men and boys than the more conventional types. It is practical, too, being easy to open and close, yet never falling open unexpectedly when in the pocket. Besides, it can be made highly ornamental with tooled or embossed designs.

In the accompanying sketches are given the layouts for both a six- and an eight-sided purse, and others with five or ten sides may be constructed just as easily. In the case of an eight-sided purse, an octagon is first drawn on paper with compass and rule. If this octagon is inscribed in a 3-in. circle, the purse will be a good size. The pattern is then completed as indicated, and the paper cut out and folded.

The leather should be what is known as "tooling calf." A piece 7 in. square or 7 in. in diameter will be large enough. Transfer the pattern to it and cut it out carefully.

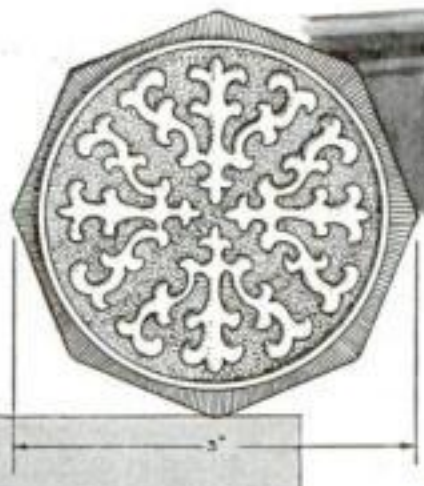
The designs are the next consideration. That for the large flat area on the back of the purse may be traced on thin paper from the full size detail and transferred from the paper to the leather or to a piece of battleship linoleum, depending upon whether the design is to be tooled with a blunt, round awl or embossed by means of a linoleum die as described in previous articles in this series (P. S. M., Nov. '29, p. 102; Dec. '29, p. 100; Jan. '30, p. 100; etc.). In either case, the design should stand out in bold relief against a stippled background. The stippling may be done with the point of a hollow nail set, dot by dot, or with a stippling punch made by grooving the end of a nail.

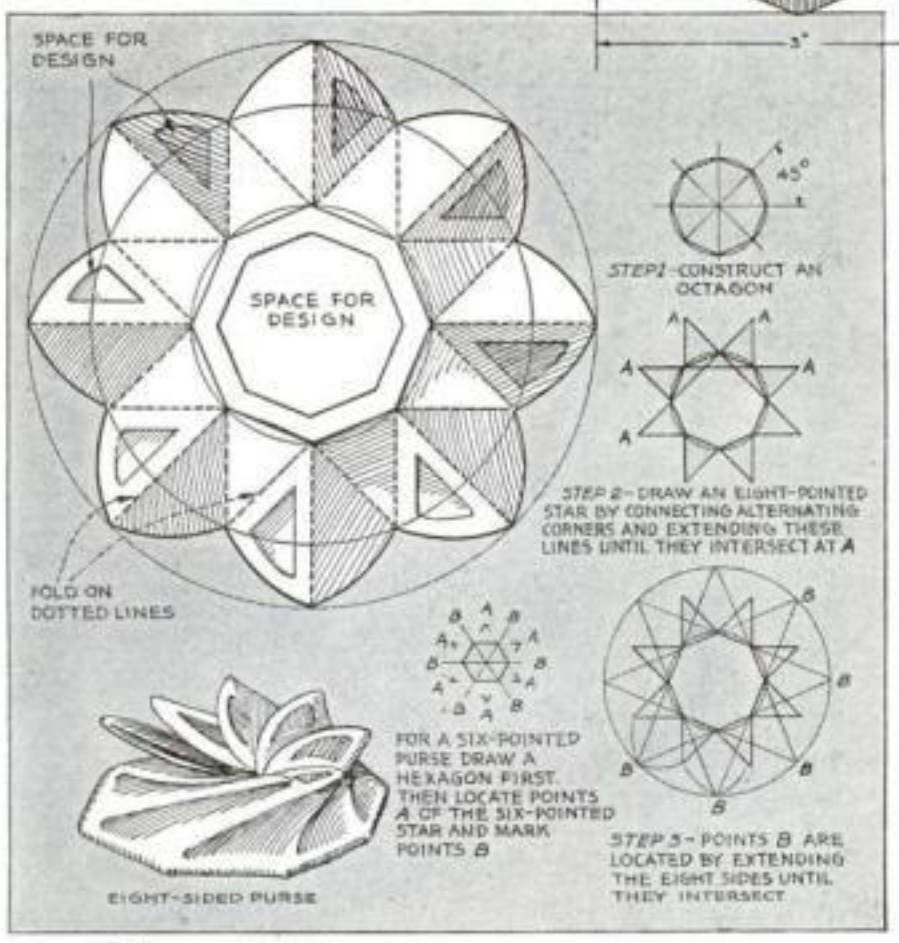
The ornamentation on the ears or points of the purse should correspond in style and execution with the main design on the back. A sample design is given full size in order that it may be traced directly.

If the leather is a little stiff or thick, the lines for folding may have to be thinned or grooved a trifle with the point of a knife. By dampening the purse slightly and leaving it overnight under a light weight, it will become well creased.

The leather may be left entirely in its natural color or the stippled background of the ornamented portions may be toned with some light color by the methods described in former articles. In either case the surface should be given a wax finish with either shoe dressing or floor wax. This will preserve the leather and bring out its natural beauty.

A practical purse for men. *At left:* Design suggestion for the back of the purse.

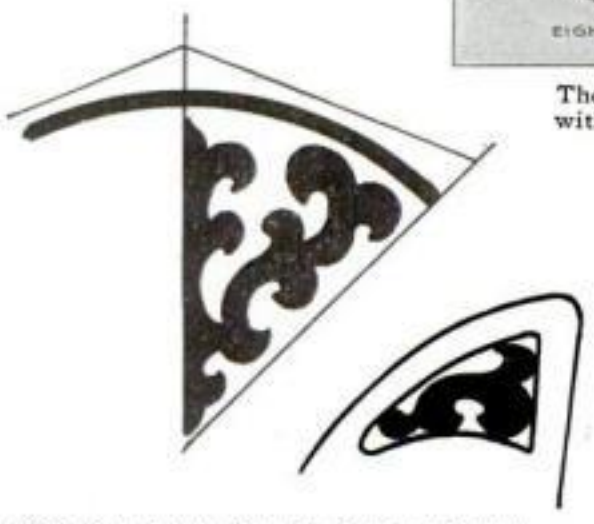




The steps in laying out a six- or an eight-pointed purse with a compass and straightedge. A completed purse.

In order to insure against any error in cutting the leather, it is best to cut and fold a paper pattern first.

If a design is to be embossed on the back of the coin purse, the die can be made by carving the pattern on the face of a piece of linoleum. *Below:* Putting the die in place.



A full size layout for the back and ears according to the design suggested above.

Do You Play Golf?

Yes? Then it's about time to repair those pet golf sticks. If you are in doubt as to what to do and how to do it, don't fail to read an article on this subject by Alex Morrison, noted authority on golf technique, which is scheduled to appear in the April, 1931, issue.

"Fast and stable—results in rough water, very good," was the laconic way in which Mr. Jackson summed up a rigorous test of his new racer. He is a naval architect and for the past four years has specialized in the design of hydroplanes for many prominent outboard-motor racing drivers.

Easily Built Outboard Racer

A streamlined hydroplane of improved design which can be constructed by beginners at a surprisingly low cost

By
WILLIAM JACKSON

SPEED, stability, strength, and simplicity of construction are the outstanding features of this outboard racing motorboat. It is a racer such as every outboard enthusiast wishes he owned whenever he sees a regatta and hears the full-throated roar of the boats as they tear across the starting line. So fast, indeed, is this boat that it provides the thrill of an airplane without the hazards.

The streamlining of the hull gives the boat increased speed; at the same time, the sides are built at such an angle that the danger of capsizing is reduced. The racer has been thoroughly tested with a very powerful "pepped-up" motor to be certain that the construction would endure with the lower powered motor for which it is intended. It is designed for a "B" or "C" motor, although it may be used with a "D" motor.

With "B" and "C" motors a speed in the neighborhood of 40 miles an hour may be confidently expected, and with a "D" motor a speed well over 40 miles, provided conditions are exactly right. The author cannot guarantee this performance, but from the showing made by his own boat and from long experience in racing, he feels that record speeds are within the reach of anyone who will take sufficient pains with the construction of the hull and will see that his motor is operating at its highest efficiency.

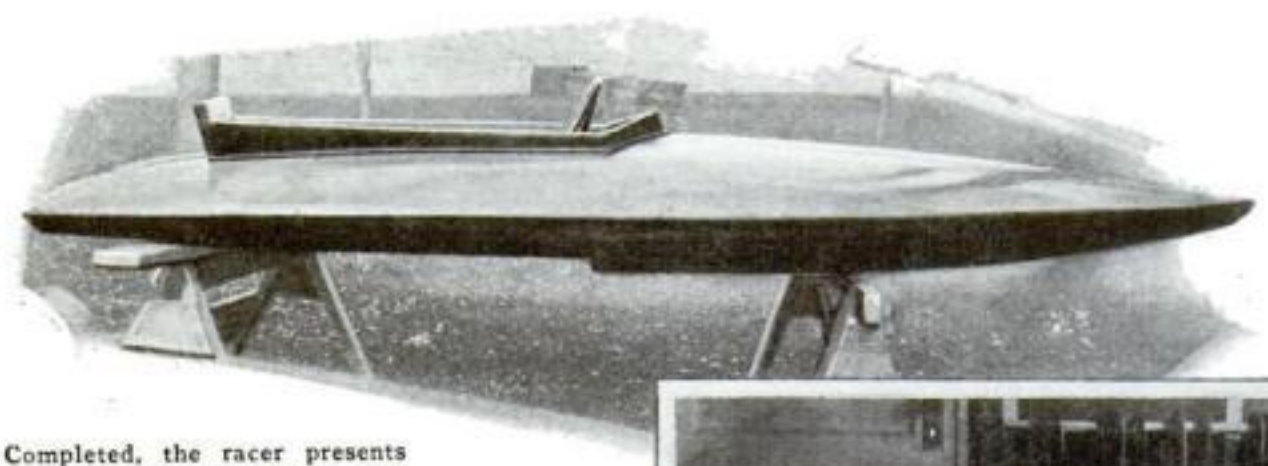
Complete with steering gear, the boat weighs 156 lb. This makes it eligible for racing in Classes B and C, 150 lb. being the minimum in these classes. If a canvas deck is used instead of the wooden deck, the weight of the hull will be less than 150 lb., making the boat eligible for Class A only. Amateurs who are beginners race in Division 1, while those who have competed in fifteen or more heats or races must enter in Division 2.

The amateur with little or no boat building experience can construct this boat, but it will be necessary for him to study the plans and the bill of materials carefully. Two blueprints also have been prepared, which will be found of great help; they contain drawings on a large scale and are much easier to follow than the necessarily small illustrations accompanying this article. To obtain them, send 50 cents for POPULAR SCIENCE MONTHLY Blueprints Nos. 128 and 129 (see page 117).

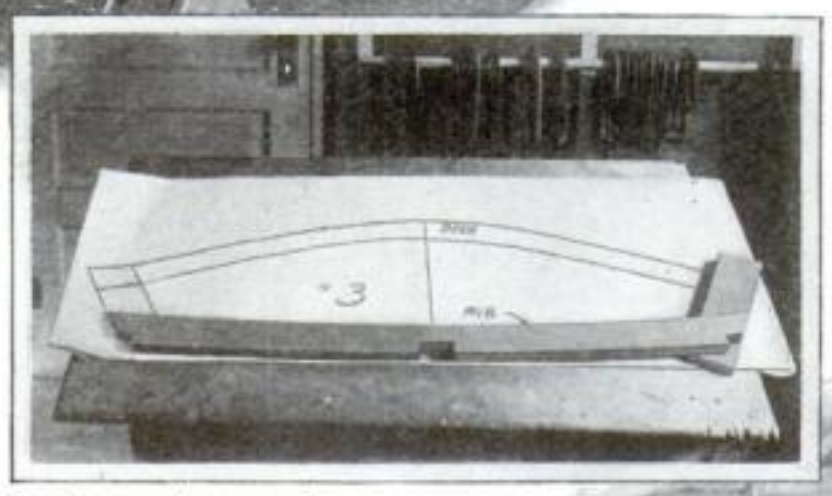
A small kit of woodworking tools is sufficient for the work, but as many of the pieces must be held temporarily in place with clamps, it is necessary to have about eight 6-in. C-clamps. As to materials, these can be obtained for approximately twenty-five dollars; at least, that is what they cost the writer.

The first thing to make is the form upon which the boat is built. The plans give complete details of this form, which can be sawn out of pine or any lumber available. It is a good idea to attach legs to this piece, as it makes an excellent support for the hull (see photograph below).

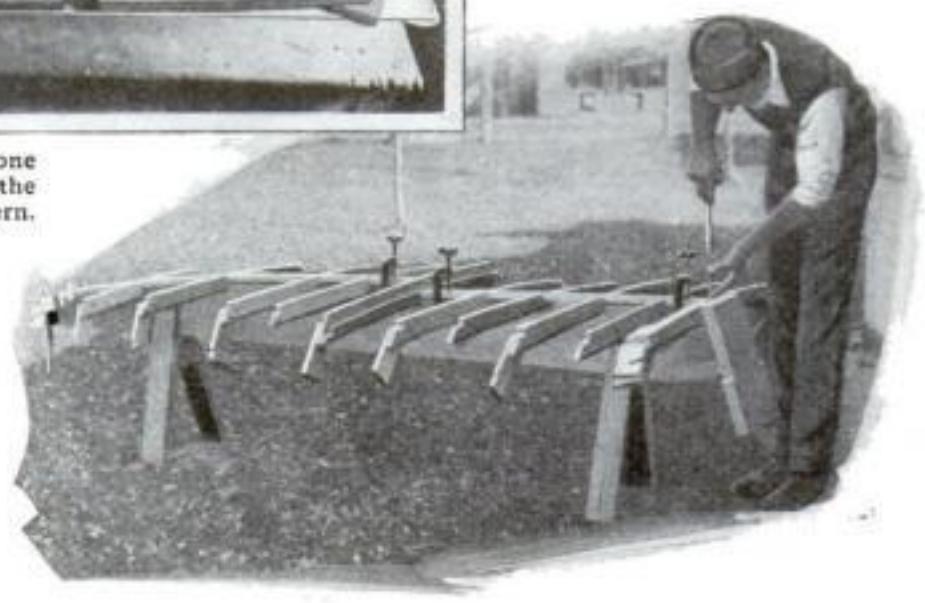
Before constructing the frames, we must first draw each of them full size on heavy building paper. Fold the paper in the middle and draw half of the frame as shown on the plans. Go over the lines with a toothed wheel or use any other convenient method of transferring them to the other half;



Completed, the racer presents a bulletlike appearance that is indicative of its performance.



Laying out the parts for one of the frames by placing the stock over a full size pattern.



The construction of the hull is begun by clamping the keel pieces and frames in place on a wooden form (see drawing, page 93). Notice convenient method of supporting the form by providing it with legs.

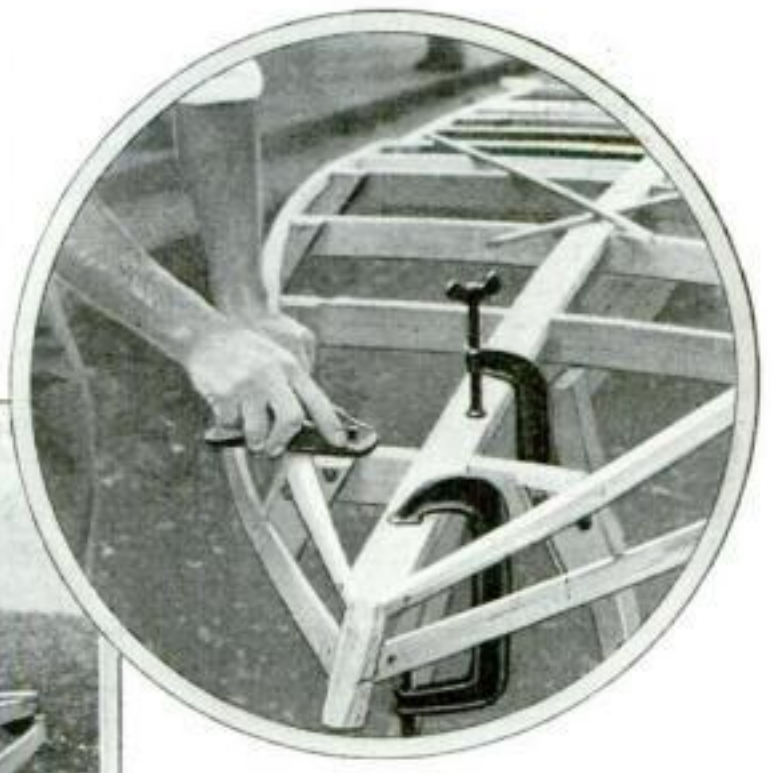
then, when the paper is unfolded, you will have a pattern of the whole frame. To transfer this outline to the boards, mark the lines of the pattern on the wood with the toothed wheel.

Cut out all bottom members first. Studying the plans, you will find that the bottom members of frames Nos. 8, 7½, 7, 6½, and 6 are alike.

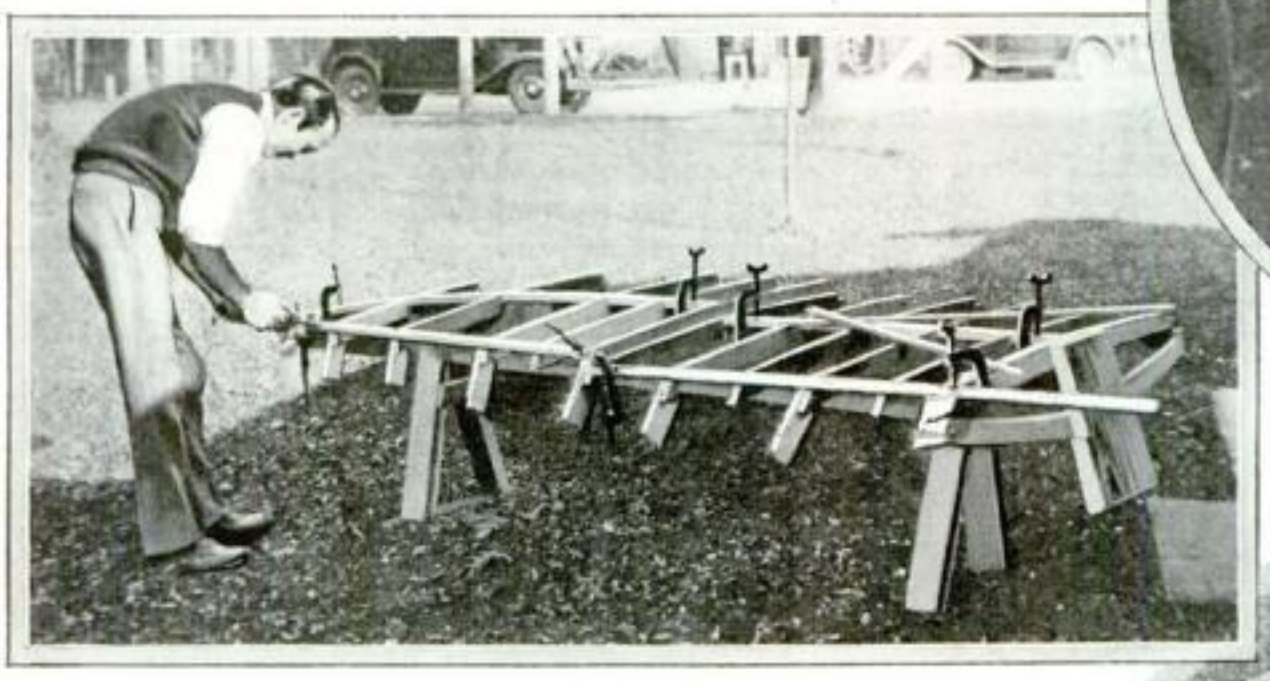
To assemble the side members of each frame with the bottom members, lay the pieces on the paper pattern so as to conform to the outline and fasten them together with two ¼ by 1¾ in. carriage bolts.

When the transom and frames are assembled, lay them in their respective places on the form. Cut the keel pieces to the proper lengths and clamp them to the form temporarily. Lay a light batten along the side members and mark the bevels on the frames. When the frames are beveled, fasten the keel to each with two 1¾-in. No. 8 screws.

After the frames are secured

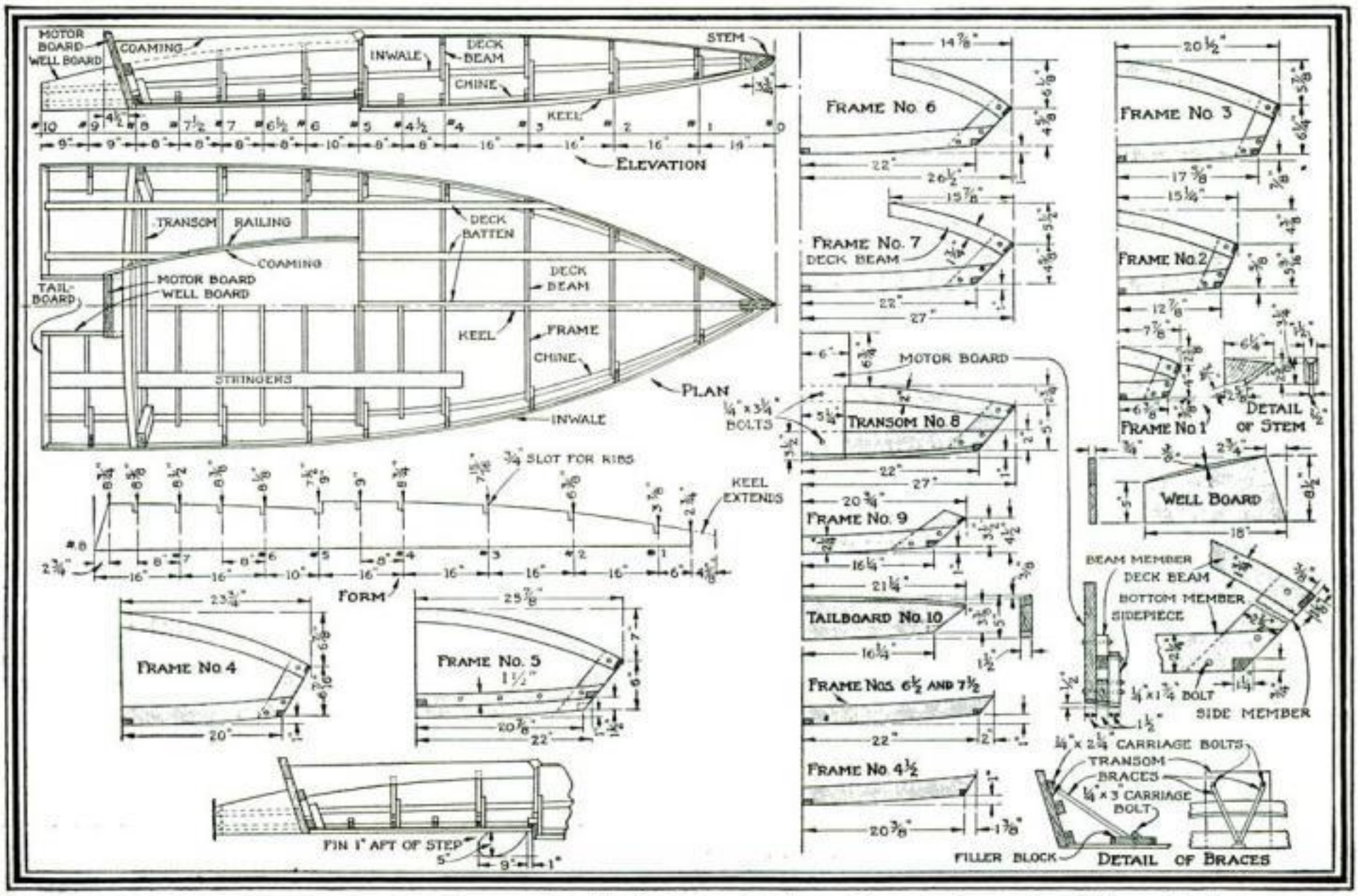


Before applying planking, smooth all projecting joints with a plane.



The author at work putting the chine piece in place along the sides of the hull

Rear view of the completed frame showing the tailboards, well boards, and motor board.



Assembly drawings of the completed frame and details of the form, fin, braces, frames, and motor board. The work of constructing this racer can be made easier through the use of the larger drawings included on Blueprints Nos. 128 and 129.

to the keel, tack strips from the floor to the transom and step so as to hold the frames level with each other. Also fasten strips to hold the step and the transom square. The stem is now fastened to the end of the keel with two 1¾-in. No. 8 screws.

Bevel the rear chines as shown in the drawings and fasten them to each frame with one 1¾-in. No. 8 screw. Fasten the forward chines without beveling, as these chines can be beveled after the framework is finished. Drive the screws which secure the chines first on one side, then on the other, because to fasten one whole side would pull the boat out of shape. Bevel the keel on the end and fasten the chines to the keel with two 1¾-in. No. 8 screws.

We are now ready to attach the tailboard and well board. The side of the motor board is liberally coated with marine glue where the joint is to be made, and cloth is laid on the glued surface. Then each well board is fastened to the motor board with seven 1¾-in. No. 8 screws.

The tailboards are now fastened to the well boards. Glue the joints, lay the cloth on the glued surface, and fasten with five 1¾-in. No. 8 screws. Cut a notch for the chine halfway through the tailboard, and fasten the chine to the tailboard with one 1¾-in. No. 8 screw.

Cut a notch halfway into the tailboard for the sheer batten, sometimes referred to as the inwale; and fasten the sheer batten to each of the frames and to the stem with one 1¼-in. No. 8 brass screw driven into each part.

The completed frame is now trimmed and faired.

How to apply the side and bottom planks and either a canvas or a wooden deck will be told in the April issue.

If you encounter any problems in the construction of the boat thus far, Mr. Jackson will endeavor to answer your questions, provided you inclose a stamped, self-addressed envelope. Be as brief and definite as possible and address him in care of this magazine.

LIST OF MATERIALS

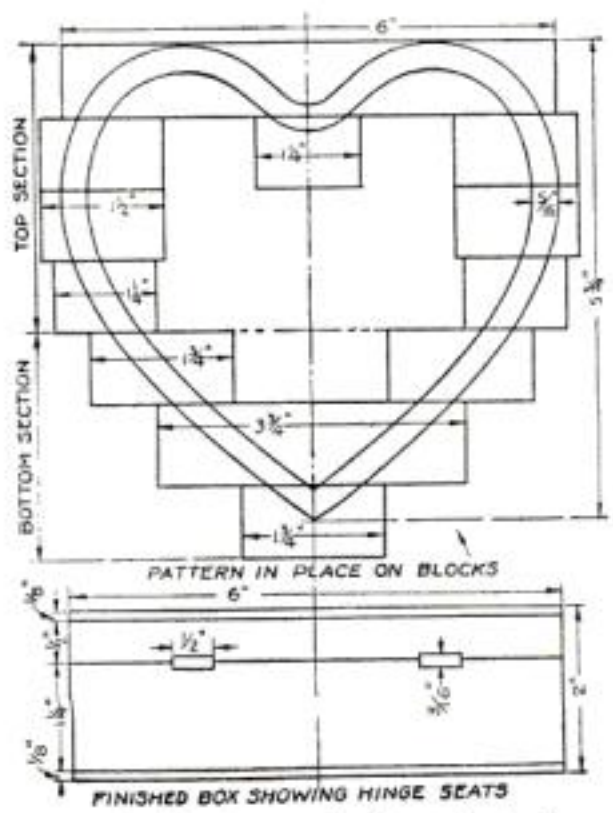
Form, 2 by 10 in. by 10 ft., any rough lumber.
Planking, 5/16 by 8 in., mahogany, white cedar, red cedar, pine, or cypress. For side planks, 2 pcs. 12 ft.; bottom planks, 2 pcs. 12 ft., 2 pcs. 10 ft., and 2 pcs. 8 ft.
Decking, ¼ by 10 in., mahogany or cedar.
Coaming, 2 pcs. ⅜ by 6 in. by 4 ft., mahogany or spruce.
Floor boards, 5 pcs. ⅜ by 3 in. by 4 ft., spruce or yellow pine.
Stringers, 2 pcs. ¾ by 3 in. by 6½ ft., spruce or yellow pine.
Transom and tailboard, 1 pc. 1½ by 6 in. by 14 ft., mahogany or spruce.
Well boards, 1 pc. 10 in. by 3 ft., mahogany or spruce.
Motor board, 1 pc. 1½ by 12 by 16 in., mahogany or spruce.
Keel, 1 pc. ¾ by 2 in. by 10 ft., mahogany or spruce.
Chines, 2 pcs. ¾ by 1¼ in. by 5 ft.; forward chines, 2 pcs. ¾ by 1 in. by 7 ft., mahogany or spruce.
Battens, 4 pcs. ⅜ by 1½ in. by 10 ft., mahogany or spruce.
Sheer batten, 2 pcs. ⅜ by 1⅛ in. by 12 ft., mahogany or spruce.
Deck batten, 5 pcs. ¼ by 1¼ in. by 10 ft., mahogany or spruce.
Ribs, 1 pc. ¾ by 12 in. by 12 ft., mahogany or spruce.
Deck beams, 1 pc. ¾ by 12 in. by 8 ft., mahogany or spruce.
7 gross 1-in. No. 6 F. H. brass screws; 6 dozen 1¾ in. No. 8 F. H. brass screws; 2 dozen 1¼ in. No. 8 F. H. brass screws.
48—¼ by 1¾ in. carriage bolts; 12—¼ by 3¼ in. carriage bolts.
¾ lb. 1-in. copper clinch nails; ¼ lb. ¾-in. copper clinch nails.
1 quart "C" quality marine glue.
2 pcs. ¾ in. by 2 ft. steel tubing.
1 fin about 5 by 9 in.
Paint, varnish, strips of cloth, etc.

Heart-Shaped Box for Trinkets

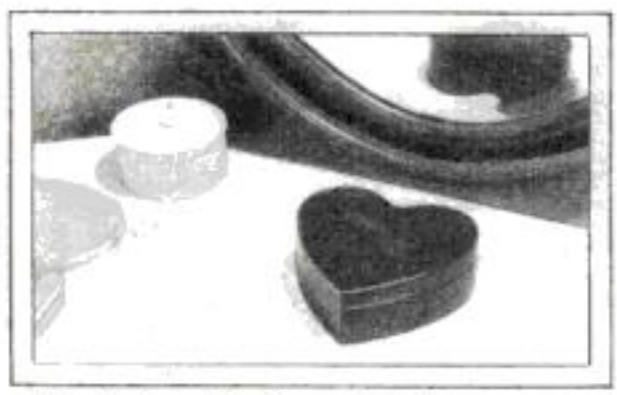
IF YOU like to do work that is out of the ordinary, you will enjoy making the heart-shaped trinket box illustrated. Besides being an attractive and interesting project, it is inexpensive, since scrap pieces of mahogany, walnut, or other hardwood serves as the stock.

The body of the box is glued up from 1⅞-in. blocks of wood and cut to shape on the band saw. In cutting the blocks, care should be exercised to keep them square; this will save time when gluing them together.

When the blocks are finished to size, put them in position as shown in the drawing and clamp them tightly together. Then use a paper pattern to mark the shape, both inside and out. This done, take off the clamp or hand screw and glue the blocks together, the four top layers in one section and the bottom three in another. While waiting for the glue to dry, cut the top and bottom pieces to shape. In the writer's box these were cut from one piece so that they both had a knot in the center, giving the finished box the appearance of being carved from a solid block of wood.



How the blocks are glued together to form the sides of the box. Rear view of the box.



Closed, the trinket box gives the appearance of having been shaped from a single block.

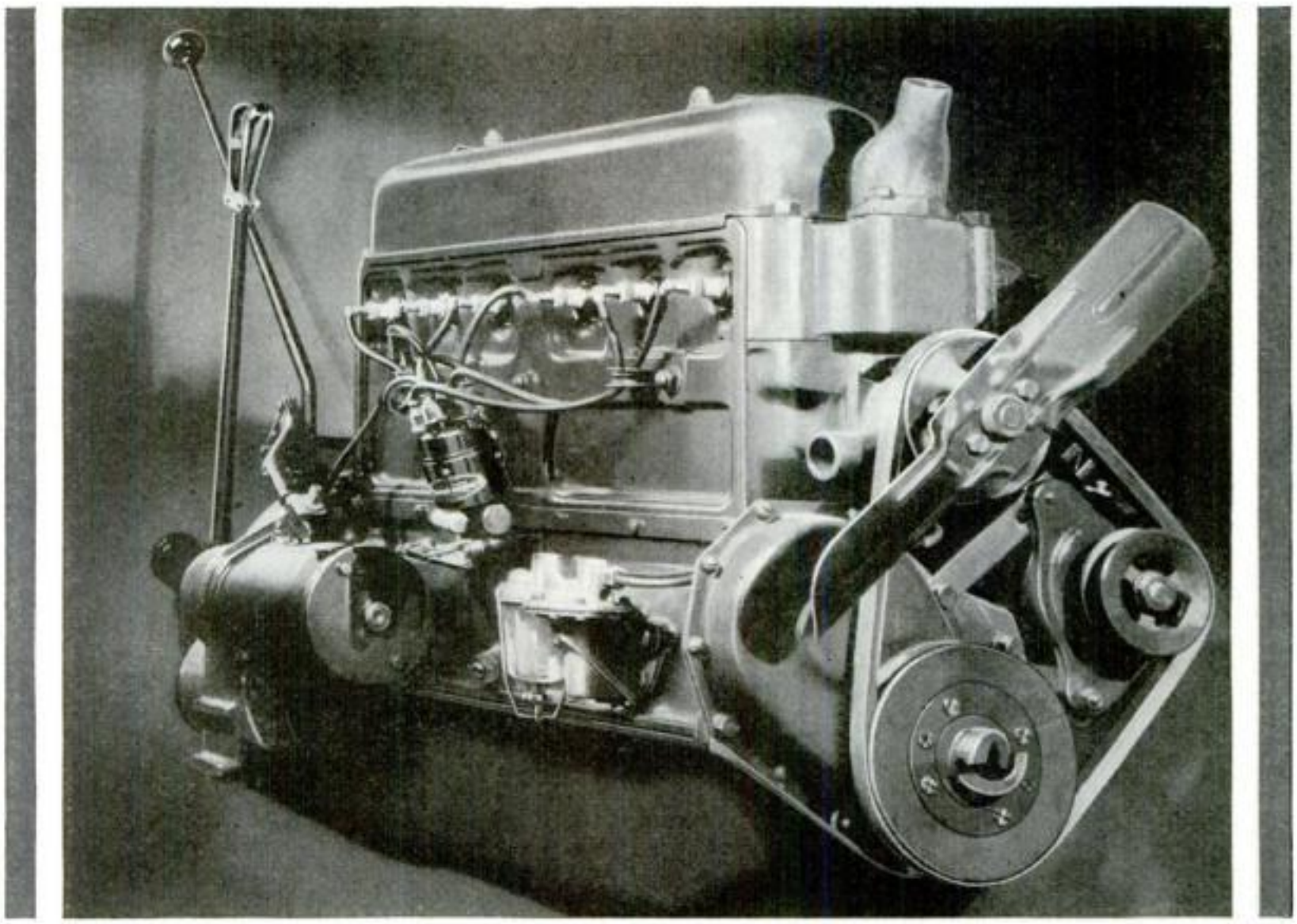
When the glue dries, the two sections are ready to be band-sawed to shape. Then the sections are glued together and, after the glue dries, are smoothed to the line with plane, rasp, and sandpaper. At this point finish the inside.

Next, glue the top and bottom in place with the grain running in the same direction as the heart points. Smooth off the edges and draw a line 11/16 in. from the top all around. Using a hack saw and following this line, cut clear through to separate the top from the bottom.

In placing the hinges, fasten them to the bottom half first, each with one screw, and then fasten one hinge in place on the top with a single screw. Test the box to see that it closes and then drive the remaining screws.

The box illustrated was French polished, although three coats of shellac well sanded and then a finishing polish with wax will serve.—L. M. Curtis, Jr.

On the dresser, the box forms an appropriate little depository for jewels and keepsakes.



THE CHEVROLET SIX ENGINE

has many features of design unusual in a low-priced car

If you are interested in the mechanical side of motor cars—lift the hood of the new Chevrolet. You will find a number of very interesting features in the engine of this car—many points unusual for a car so low in price.

To begin with, Chevrolet pioneered the Six among cars of the low-price field—and today's motor brings out the full possibilities of this principle. It develops 50 horsepower at about 2600 r. p. m. and combines this power with marked smoothness, quietness and economy of operation.

Further contributions to smooth performance are made by the Chevrolet crankshaft, and the construction of the cylinder block. The crankshaft is unusually heavy, weighing 48 pounds. A simple but effective harmonic balancer adds to the efficiency of its operation. And the cylinder block is made stronger by the use of strong ribbing reinforcements. In fact, so efficient is this new construction that a 40 per cent increase in rigidity has been obtained with only a 1½ per cent increase in weight.

The Chevrolet motor reveals many important advancements that have a direct bearing on other phases of the car's performance. An accelerating pump provides extra power when needed. A hot spot manifold assists in quick starting. A combination air cleaner and flame arrester cleans all air that goes to the cylinder walls and protects against engine back-fire. A crankcase ventilator removes gas fumes from the crankcase. A steel ring has been added to the fly-wheel to provide longer life and smooth, easy engagement of the starting motor. The special design of the Chevrolet combustion chamber permits high compression with ordinary fuels, and results in unusually high gasoline mileage.

Every man who knows engineering will appreciate the quality and advancement represented by this new Chevrolet power plant. It sets a new engineering standard for cars in the low-price field.

Chevrolet prices range from $475 to $650, f. o. b. Flint, Mich., Special equipment extra
Chevrolet Motor Company, Detroit, Michigan, Division of General Motors Corporation

NEW CHEVROLET SIX

The Great American Value

With this inexpensive photographic outfit you can

Make Your Own Enlargements

By
EVERETT EAMES

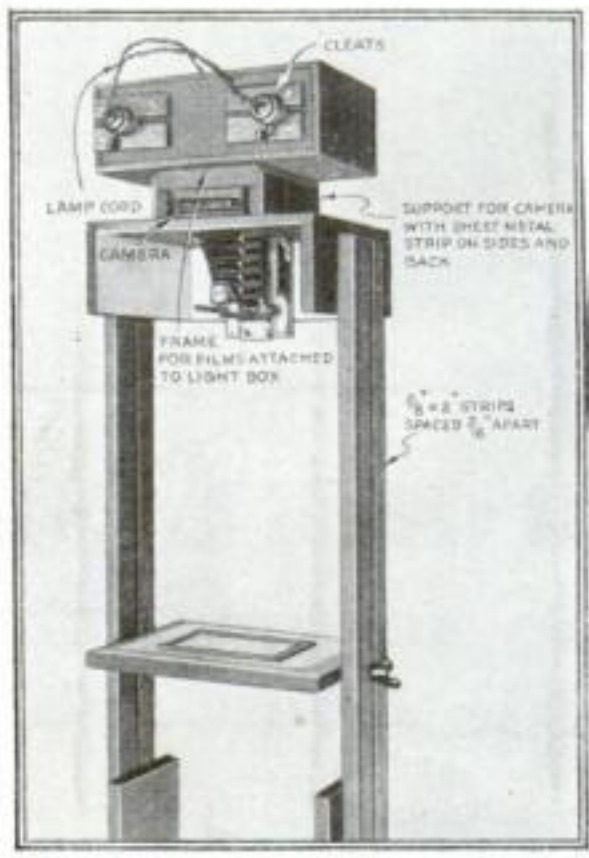
EVERY camera owner has wished at times for enlargements of some of his pictures. Enlargements made commercially are, of course, expensive, and enlarging cameras are almost prohibitive in price, but an enlarger that will produce perfect pictures can be made with no other materials than a small amount of pine or other soft lumber, two 100-watt lamps, a pair of ⅜-in. wing nuts and bolts, and the camera with which the pictures are taken.

The outfit shown here is designed to make pictures 11 by 14 in. and delivers its light by indirect illumination. First make the lamp box of ⅜-in. stock and cut a central hole ⅛ in. larger all around than the film size of the camera; that is, for a 2¼ by 3¼ in. film cut a 2½ by 3½ in. hole. Cut holes for the lamp sockets and hold the sockets in place with cleats as shown. Leave the top uncovered until the last, and give the inside three coats of flat white paint.

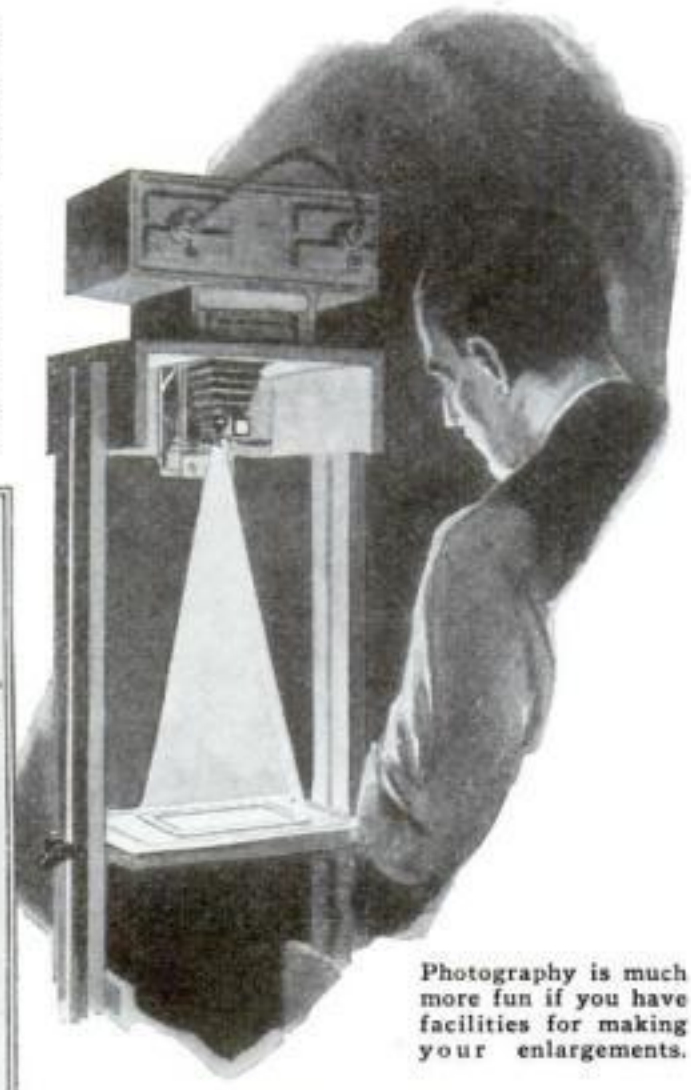
A sheet of glass of convenient size is placed over the film opening on the inside; its function is to maintain a dead air space between the inside of the box and the film to prevent overheating.

Next make the film-holding frame of ⅞-in. stock 1¼ in. wide; this should have an opening 2¼ by 3¼ in., or whatever the size of the film is. Two small rabbeted cleats are prepared and glued and bradded to the outside as shown so that two sheets of glass with the film between may be slid into position over the opening. A strip of wood or cardboard is glued against one end of the cleats to prevent the film and glass from sliding through. The completed frame is then held snugly against the opening in the box with four screws.

The support for the camera and light box is what amounts to a box with one side and the bottom open and with a rectangular hole in the top through which the camera bellows can pass. On the upper side of this box is mounted a three-sided support for the



The enlarging machine ready for use with the paper and mat in place on the movable board.



Photography is much more fun if you have facilities for making your enlargements.

light box with a strip of sheet iron or brass arranged as shown in the drawings to center the light box over the camera. Note particularly that the film frame is set directly over this support and both must have the same outside dimensions.

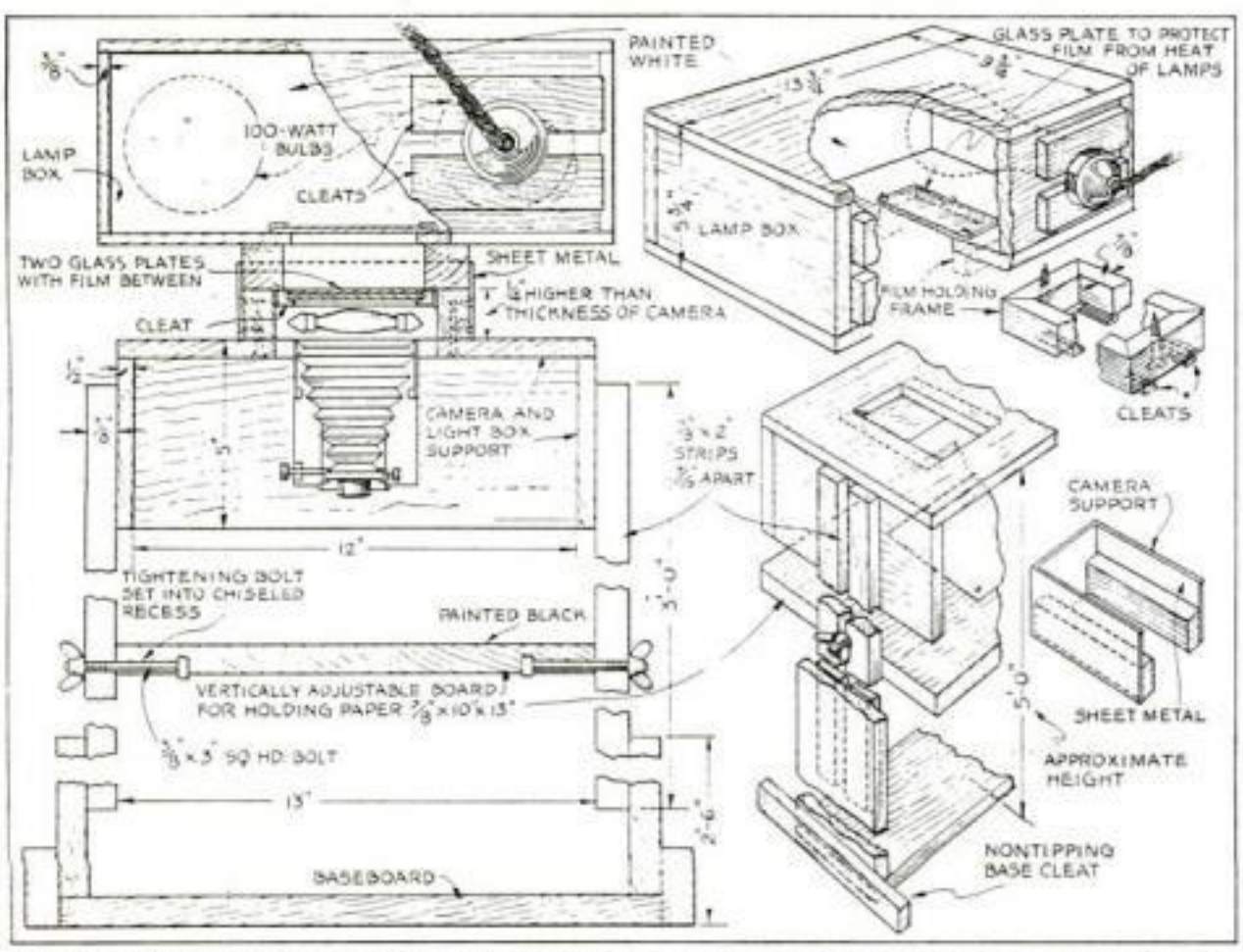
To the sides of the camera-holding box or platform are screwed 2 by ⅞ in. by 3 ft. strips. There are two of these on each side set 7/16 in. apart. These pieces, in turn, are attached to two boards that reach to the base, as indicated in the drawings.

The sliding board for holding the paper is made of ⅞-in. stock and varnished to prevent warping. Recesses are chiseled in the underside to receive the heads of the bolts, which are then secured by brads driven into the board and bent over.

The entire outfit should be painted a flat black, and the two lamp sockets connected to a single cord and plug. A supply of cardboard mats of various sizes should be prepared, and a stock of bromide paper laid in.

To operate, remove the back of the camera and set it in the position shown in the photograph. Place the film between the two sheets of glass and insert it in the film frame face down. Then turn on the lights and focus by raising or lowering the board. Make the fine adjustment for sharp focus by racking the camera bellows up or down as required.

To make 11 by 14 in. enlargements, lay another board about 13 by 16 in. across the sliding board. In printing large pictures, it should be remembered that the amount of light used is constant. When it is spread over an 11 by 14 in. surface, the time required to print will be much longer than if a 5 by 7 in. print is being made.



The front view of the enlarging outfit broken away in three places to save space, and sketches showing the construction of the lamp box, film-holding frame, camera support and main frame.

Resilvering Mirrors *at* Home

The process is neither difficult nor expensive if you use the correct formula and exercise a moderate amount of care

By
D. C. MARSHALL
Instructor, Shop Department, Manhattan Junior High School, Manhattan, Kansas

If interrupted after cleaning the glass, lay it in the tray and cover it temporarily with distilled water.

RESILVERING a mirror can be done by any home worker who uses reasonable care and sees that absolute cleanliness prevails in every stage of the process. The equipment needed is limited in both cost and amount, and no part of the operation requires exceptional skill.

The first step is the preparation of the solutions. Since the principal chemicals must be weighed accurately in grains, I shall list exactly what is needed so that the purchaser can have them weighed at the drug store or chemical supply house where they are bought. All must be pure and of the highest grade—that is, designated as c. p. (chemically pure). The list is as follows:

Nitrate of silver	306 grains
Nitrate of silver	250 grains
Rochelle salts	96 grains
Nitrate of silver	96 grains
Rochelle salts	144 grains
Nitrate of silver	96 grains
Strongest ammonia	1 ounce
Nitric acid	4 ounces
Distilled water	4 gallons

In preparing the solutions, place the 306 grains of silver nitrate in a glass or graduate and dissolve it in about 3 ounces of distilled water. To this solution add the strong ammonia drop by drop and watch the reaction. The solution will become muddy and then it will gradually clear, and the ammonia must be added until it is just clear. The next step is to dissolve 250 grains of silver nitrate in 16 ounces of distilled water. When it is completely dissolved, the two solutions are poured into a gallon bottle, and enough distilled water is added to make one gallon of solution. This bottle is labeled "Solution No. 1."

Solution No. 2 is now prepared. One half gallon of distilled water is placed in a porcelain lined vessel, and 96 grains of Rochelle salts are dissolved in this. It is then allowed to boil vigorously for one minute, after which 96 grains of nitrate of silver are added, this amount having been previously dissolved in 3 ounces of distilled water. The combined solution is then boiled ten minutes, cooled, and filtered into a half-gallon bottle, and the bottle is filled up with distilled water to make a full half gallon.

Solution No. 3 is prepared in exactly the same way as No. 2 except that the quantity of Rochelle salts used is 144 grains, with 96 grains of silver nitrate. These solutions must not be allowed to touch your hands; indeed, it is a good idea to wear rubber gloves. If by accident you do stain your hands with the silver nitrate, the marks can be removed with hot hyposulphite of soda (hypo) provided the cleansing is done immediately.

The prepared solutions can be kept in stoppered one-gallon bottles. Notice the oilcloth tray in foreground.

The second step is the preparation of the tray for holding the mirror. Place a piece of oilcloth on a flat table top and lay the mirror on the oilcloth so that there will be an edge protruding on all sides. Place strips of wood under the oilcloth around the edge of the mirror so as to form a tray to hold the silvering solution.

The preparation of the glass is the third step in the process. Mirrors are of two kinds, the older type which is not painted on the back and the modern type which has a coat of paint over the silver to protect it. If the mirror is of the first kind, the silvering may be dissolved with nitric acid applied on a swab made by winding absorbent cotton on the end of a glass rod. If it is the second type, the paint must be removed with varnish remover and then the silver dissolved with acid. Do not scratch the glass, for the slightest defect will be visible when the mirror is finished. The acid is washed off, and the glass is again washed with soda to remove any traces of grease that may be present. After this washing, the side to be silvered must not be touched with the fingers, as the oil of the skin will adhere to the glass and cause a spot in the silver. The glass now should be rinsed several times with clean water and finally with distilled water, and it should not be allowed to become dry. If you are interrupted, lay the mirror in the tray and cover it temporarily with distilled water.

To silver the mirror take equal parts of solutions Nos. 1 and 2 and mix enough so that there will be 4 ounces for each square foot of glass. As soon as they are mixed, pour the solution on the glass in the tray. Do not delay, for the silver starts to precipitate out immediately. After the mixed solution has been on the glass for about thirty minutes, drain it off and wash away the sediment with running water. Then cover the glass with a solution composed of equal parts of Nos. 1 and 3 and allow it to remain for a like period. At the end of this time the glass is removed from the tray and washed with running water, after which it is set up to dry. When the silver is dry, it is ready for painting.

To prepare the paint, take 1 pint turpentine asphaltum, 2 ounces damar varnish, 2 ounces white lead, and 1½ ounces of turpentine. Dissolve the lead in the turpentine and after adding the other materials stir until all are thoroughly mixed. Apply with a soft hair brush.

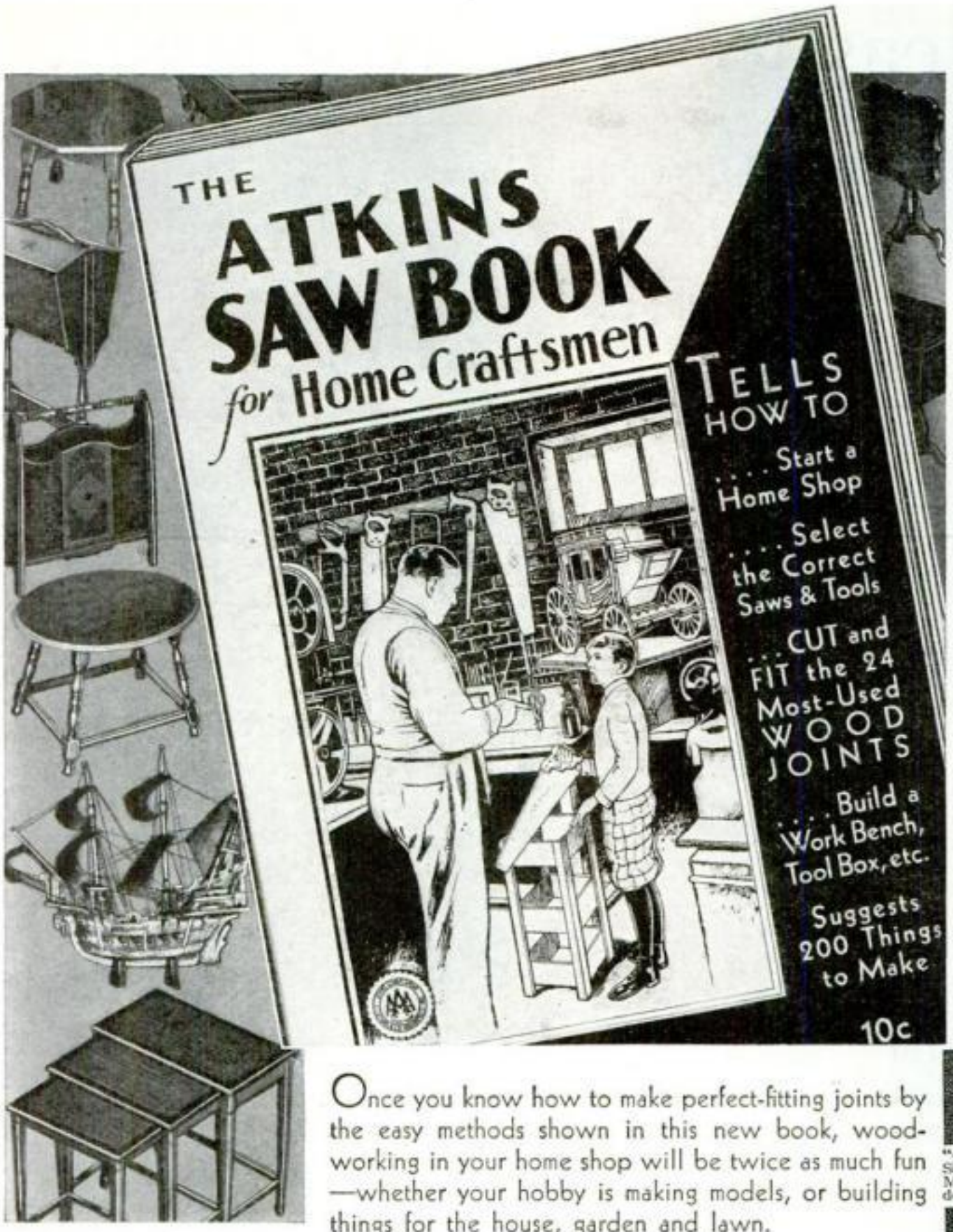
AN ALARM CLOCK THAT SHUTS ITSELF OFF

THOSE who invariably awake at the first ring of an alarm clock and dislike having to fumble in the dark to turn it off can make the clock self-stopping in a very simple manner. This is done by taking advantage of the fact that any ordinary alarm clock will stop ringing if the alarm setting hand is turned forward a distance representing about half an hour on the dial.

Having made this discovery, I soldered a strip of tin to the alarm setting handle in such a way that when the alarm goes off and the alarm-spring winding key starts to unwind, the latter will strike the tin and push it around far enough to move the alarm setting hand the distance necessary to shut off the alarm. To make the action positive and insure that the alarm winding key would not unscrew from its arbor, I soldered it, too, securely in place.

Rear view of clock showing tin strip.

This device stops the bell in about ten seconds.—H. MOORE.



It's FUN to Make JOINTS and Build Things » »

This book shows you HOW... and these saws help you CUT easier, quicker, better!

Ⓢ

Once you know how to make perfect-fitting joints by the easy methods shown in this new book, woodworking in your home shop will be twice as much fun —whether your hobby is making models, or building things for the house, garden and lawn.

The book gives you a helpful course in joinery, by a veteran craftsman who shows you how to cut and fit all these joints—butt, coped, dado, dovetail, dowel, glued, halved, lapped, mitred, mortise-tenon, rabbet, splined, and others used in home shop work.

And then he shows you how to use the joints in building an outfit for your shop, including a folding work-table, large bench, saw horse, tool-box seat and wall cabinet.

Next, comes a feature no other book offers —a complete "What to Make" reference list of job plans available to you from eight different sources. In it, he lists over 200 popular projects, and tells just where to get the plans you want. It's a "gold mine" of ideas for things to build.

Then, he explains why all your cutting jobs can be done so much easier, quicker and better with "Silver Steel" Saws. And to help you check up your tool-kit, he shows fifty of the latest types of saws and saw tools suitable for the modern home shop. Thus, it is easy for you to pick the ones you need and then see them at your hardware store.

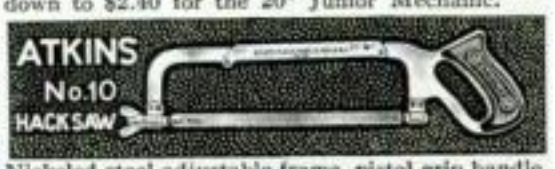
These are only four of the many valuable features in this 32-page home-workshop guide book. No wonder thousands are sending for it every week! THREE large editions have been sold in less than six months! No home-crafting book like it for only a dime!

SEND FOR YOUR COPY NOW
JUST CUT OUT THE COUPON

E. C. ATKINS and Company (Est. 1857), 428 S. Illinois Street, Indianapolis, Ind.
I enclose a dime for a copy of the new ATKINS Saw Book. (Please PRINT name, etc., below.)

Name..... Street.....
City..... State.....
My Dealer is.....

"400" and "401" are the finest Hand Saws made. Silver Steel Blades. Perfection Handles. 26", $6. Many other ATKINS Hand Saws, ranging in price down to $2.40 for the 20" Junior Mechanic.



Nickeled steel adjustable frame, pistol grip handle. Complete with Non-Breakable Blade, $2.50.

Circular Rip, Cross-Cut and Mitre Saws for fast, accurate work on any machine. 8" rip or cross-cut saw, flat ground, $2.77. 8" hollow ground No. 37 mitre saw, $4.28.

Silver Steel Narrow Band Saws are made in any length for home shop machines. 1/4" saw, $.091 per foot. 3/8" $.098 per foot. Brazing, 35c each.

The simple, easy way to cut smooth even grooves from 1/8" to 4" wide, is with dado head. No. 2 set, 8" dia. Cuts 1/8" to 5/8" grooves, $13.13.

Ask your local hardware dealer for the ATKINS Silver Steel Saws you want. If he does not have them, write us and we will see that you are supplied promptly.

Ⓢ **This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.**

New Ideas for Car Mechanics

Brake Indicator Light Burns Only When Engine Runs—Easy Way to Wash Neglected Body Top

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Archie Amos, Fort Wayne, Ind. (Figure 3). Contributions are requested from all auto mechanics.

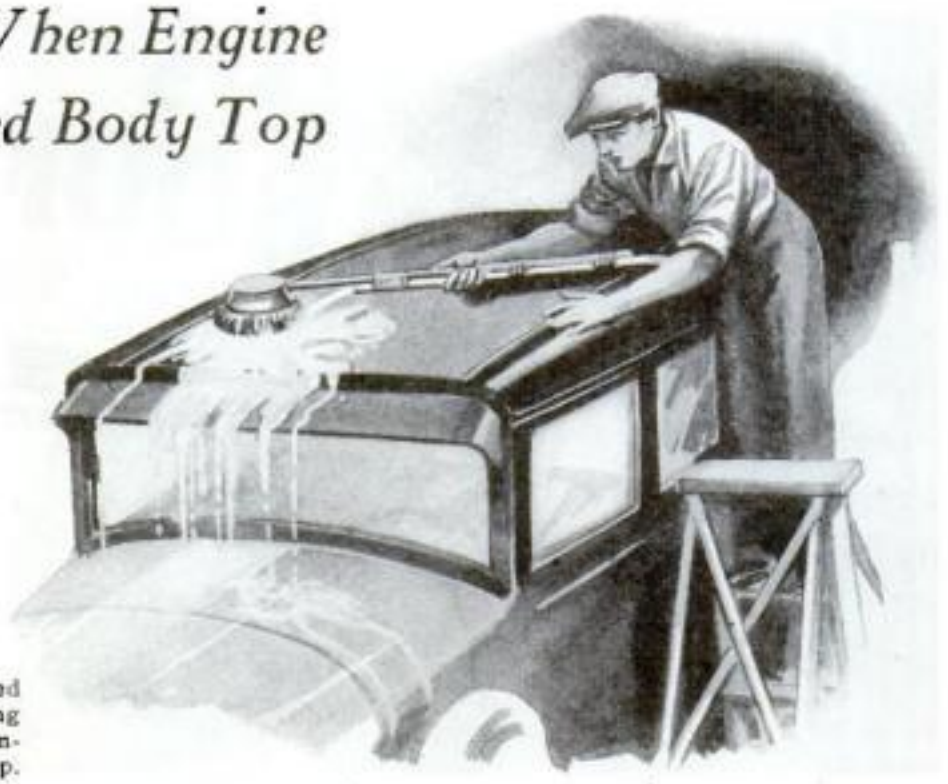


Fig. 2 shows hose attached to long handled scrubbing brush and used for convenient cleaning of car top.

HERE is an emergency brake indicator light with a novel feature. The ordinary method of hooking up such a light has one serious defect. If you forget to turn off the light when you leave the car, the light may run down your battery. By taking the current supply from the generator instead of from the battery wiring, the light will burn only while the motor is running and the emergency brake is set. The wiring is shown in Fig. 3. A jeweled radio indicator light or any other small light fastened to the dashboard of the car will serve the purpose.

Locate the wire that comes from the generator and connects to the automatic cut-out. Make connection to this wire as shown. Since the voltage on the generator side of the line may rise above six volts, use a twelve-volt bulb or a fixed resistance in series with the six-volt one.

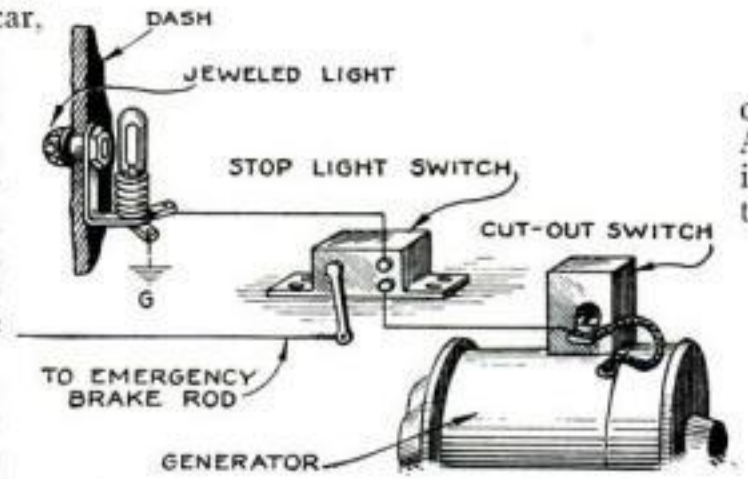


Fig. 3. Emergency brake indicator light, hooked to the generator, is on only when engine runs.

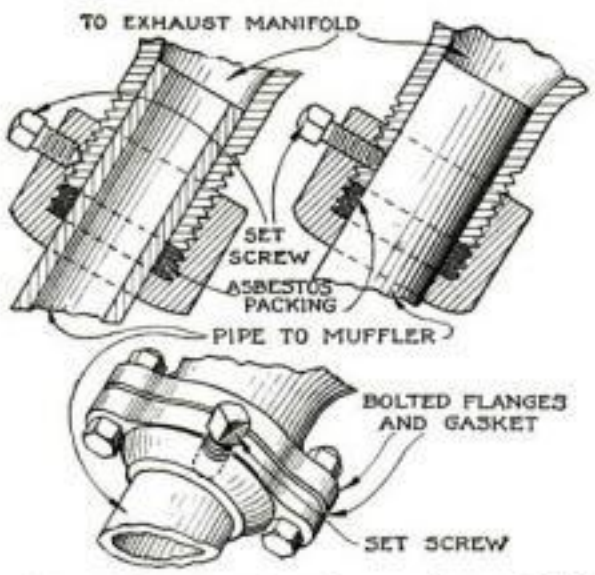


Fig. 1. Set screw in exhaust pipe manifold union holds it tight and stops escape of gas.

EXHAUST UNION CLAMP

ON MANY engines the union that holds the exhaust pipe to the exhaust manifold has a tendency to come loose. And when it does, the leaking gas makes an objectionable noise. Figure 1 shows a way to overcome the trouble. First screw the union as tight as you can get it. Then drill a hole through the shell and tap it for a set screw. Better still, run the set screw through the wall of the exhaust pipe.

CLOTH HOLDS SCREW

MANY useful ideas for holding screws so as to start them in hard-to-get-at places have appeared in POPULAR SCIENCE MONTHLY. Figure 4 shows one of the most ingenious tricks that we have described. First take an old rag, one that tears easily is best, and push the point of the screw through the cloth near the center. Next place the screw driver blade in the slot of the screw head and pull the cloth back over the blade with a twisting motion. The pull of the cloth will hold the screw in place on the end of the blade until you get it started in the thread. After it has taken hold, pull the cloth over the head of the screw.

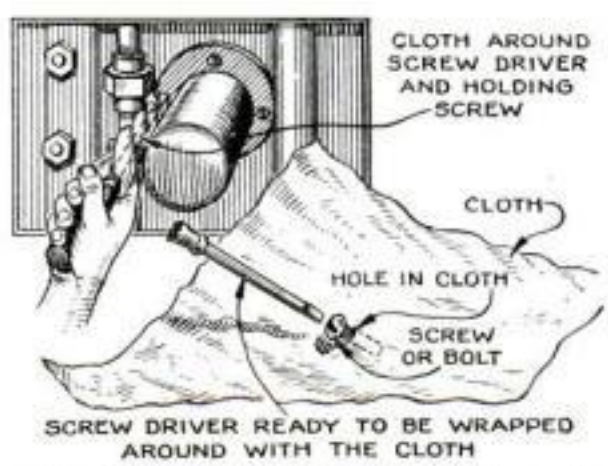


Fig. 4. Screw pushed through a cloth can be held securely and threaded into hard places.

WASHING AUTO TOPS

AUTO owners who take care of their own cars often neglect to clean the top. A simple solution of this problem is shown in Fig. 2. Take a wall brush and attach to the handle a short length of garden hose, binding it at several points with tire tape. Place a hose union at the handle and have the brush end of the hose a few inches from the head of the brush. No nozzle is necessary. When you want to clean the top fasten the brush to the end of the garden hose and turn on the water. A few sweeps of the brush and the job is easily and quickly done.

SUITCASE CARRIER

IF YOUR car is fitted with the mudguard bumpers now so popular, you can fit a carrier for a single suitcase or similar package as shown in Fig. 5. Most of these bumpers are of the double bar type and there is plenty of space for a board or plank between the two bars as indicated. Temporarily, the board can be held in place with heavy nails driven in forward of the bumper bars. The top of the suitcase can be lashed to the spare tire.

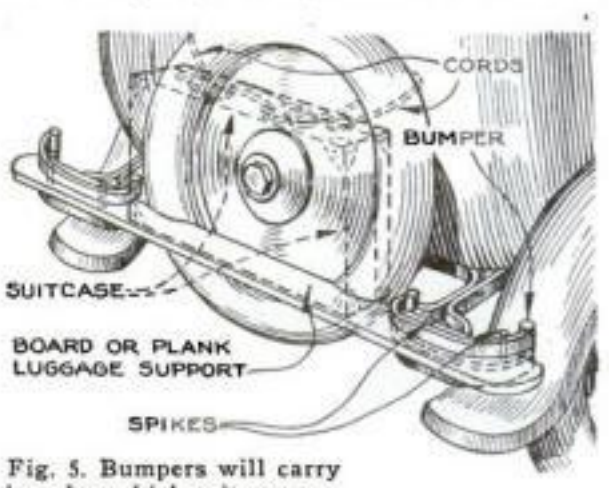


Fig. 5. Bumpers will carry board to which suitcase can be strapped while on a trip.

While this luggage carrier does not look as well as a commercial one, it will serve in an emergency.

NOW YOU CAN BUILD A BOAT . . . OR FIX A CHAIR

with the strongest adhesive known. Casco Waterproof Glue—the same glue used by the largest boat builders, piano manufacturers and woodworking plants—is now available in smaller packages for home craftsmen, cabinet makers, carpenters—everybody with something to be glued *that must stay glued.* Casco glues wood to wood, metal, glass, leather, cloth, paper—*everything for everybody.*

CASCO GLUE

TRADE MARK REG. U. S. PAT. OFF.

WATERPROOF . . . . PERMANENT

Anything glued with Casco stays glued—permanently. Casco is so strong it will withstand a pulling pressure of over 3800 lbs. per square inch on Hard Maple (U. S. Government Test). Neither heat nor moisture have any effect on a Casco Glue joint. It is so adhesive that it is used in the manufacture of laminated bowling pins—a test for glue if there ever was one.

Whether you merely tinker about on minor home repair jobs; build complicated models; use tools as a hobby; or do cabinet work as a profession YOU CAN GLUE IT BETTER WITH CASCO—and glue it easier. Use it, and your most massive or delicate work will still be a credit to you year after year.

Let us send you a trial package

Casco is a glue of a thousand uses. It fills *every* gluing need. But don't take our word for it. See for yourself how easily it mixes in cold water, how strong, clean, practical and economical CASCO really is. Put it to any test you desire. For only 10c in stamps we will be glad to send you a liberal trial package of CASCO Waterproof Glue. With it you will receive a folder describing the many uses of CASCO on the work-bench, in the shop and around the home. Fill in the coupon at the right—NOW—including the name of your local hardware, paint or building supplies dealer.

THE CASEIN MANUFACTURING COMPANY OF AMERICA, INC.
205 East 42nd Street, New York City

THIS COUPON will bring you a package of CASCO—the glue used by leading manufacturers of furniture, pianos, doors, aeroplanes, racing shells, plywood—wherever surfaces must be glued for permanence.

The Casein Mfg. Co. of America, Inc. (P.S. 3-31)
205 East 42nd Street, New York City.

Here is 10c in stamps (stamps only, please). Send me your liberal trial package of CASCO Waterproof Glue together with the folder of CASCO'S many uses.

Name.....

Street.....

City.....State.....

The name of my Hardware, Paint or Building Supplies Dealer is:

.....

Introducing Frank Bradley, expert craftsman, who shows a friend

How to Make Mitered Joints

It's too bad you can't visit **Frank Bradley** yourself. **You'd enjoy** it—and he **would, too,** because there is **nothing he** likes better than **talking of** home workshop **matters in his** basement shop. **You'll appreciate** his skill **after reading** this article **and several** others to follow.

"Please saw this board in half lengthwise," said Frank, "and joint both edges of each piece."

By DONALD G. SAUNDERS

FRANK BRADLEY was working at his bench when the door of his home workshop opened and in walked Russell, his next-door neighbor.

"Frank, I'm up against it with another little problem," said Russell after the usual greeting. "Will you help me out?"

"Surely, if I can," responded Frank cheerfully as he adjusted several boards he was gluing up, "but you'll have to wait just a minute until I get these clamps set."

Waiting was no hardship for Russell or any other home workshop fan who had occasion to come to Frank's shop, for it was the envy of all the craftsmen in the neighborhood. Each hand tool had its place, and every machine was mounted with a thought for operating efficiency. The home workshop hobby, indeed, was a tradition in the Bradley family; even Frank's two young hopefuls, Doris and Jimmy, had their bench and tools and at this very moment were building a doll's house for a younger cousin.

"All set," exclaimed Frank, as he placed the gluepot back on the heater. "What seems to be the trouble?"

"Well," began Russell, "every time Mildred saw your wife raise or lower a window last summer without having to bother with adjustable inside screens, her soul was filled with envy, so I ordered the stock for making outside screens like yours, and it came today. The whole construction, so far as I can see, is just one miter joint after another. And I never made a miter joint in my life."

"A miter joint is easy enough to make if you start right."

"But won't I need an iron miter box? I don't feel like spending twenty dollars for a tool that I may not use more than two or three times a year."

"I'll lend you mine—"

"No, no," interrupted Russell hastily. "That isn't what I meant at all. I was wondering about the wooden miter boxes such as the old-timers used."

"They turned the trick all right," said Frank as he sharpened a pencil with a chisel, "and one would serve your purpose very well."

"Then how shall I go about making one?"

"Let me show you. It will take only a few minutes."

Frank went to a corner in which were piled scraps of stock and selected a piece of pine about 1¼ by 2¾ in.—a dressed "two by three"—and a board ¾ in. thick and about 9 in. wide, both pieces being about 3 ft. long.

"Please saw this board in half lengthwise and joint both edges of each piece on the machines," Frank said. "They will make the sidepieces. Meanwhile I'll joint the bottom piece by hand."

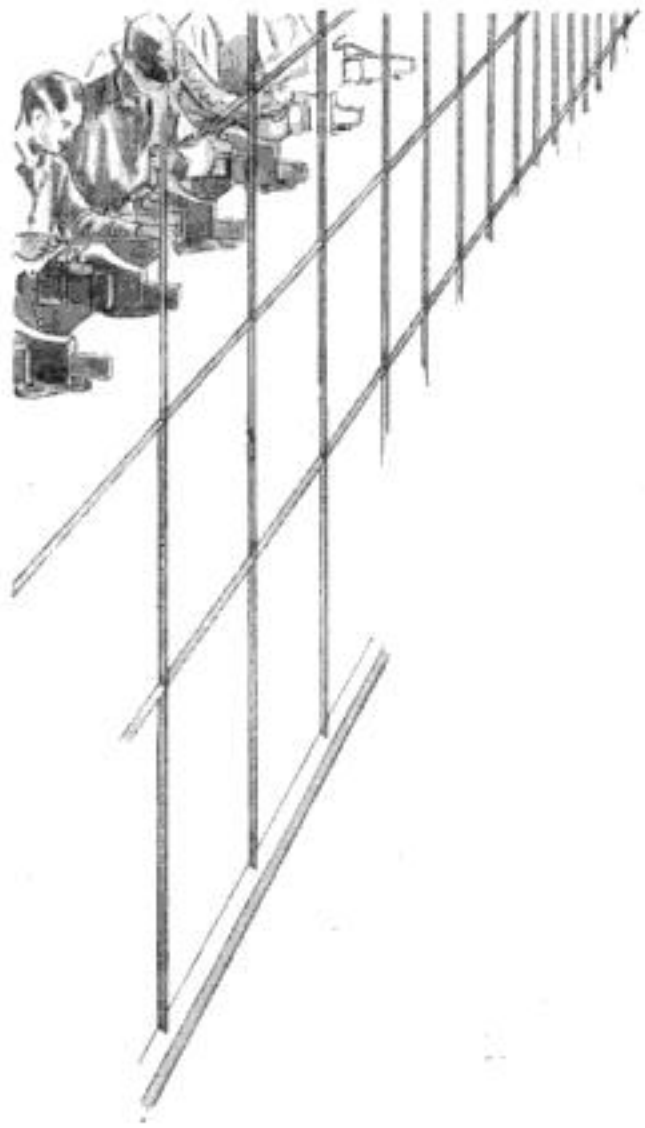
Both men went heartily to work and by the time the "zing" of the circular saw and the whirr of the jointer ceased, Frank had finished planing the bottom. Then Frank took the two sidepieces from Russell and proceeded to nail them in place along the edges of the bottom piece.

"I had guessed that far," said Russell. "My chief perplexity was how to lay out the cuts so that they would be exactly at forty-five degrees to the center line of the box."

"Here's where your geometry will come in handy," laughed Frank as he took a steel framing square from its rack. "Let's place identical figures on each edge of the square, say eight, so that they coincide with the inside top edge of the backpiece —and keep the square about in the middle of the box. This gives us the angles, and all we have to do is to make two pencil marks across the top edge of each sidepiece. Then we place the square on its edge in the box and mark from these lines to the bottom. We must make similar marks on the outside, too. What's hard about that?"

"Nothing," admitted Russell. "I should have figured it out myself. I guess most folks forget their geometry if they don't use it."

"The next thing," Frank went on, "is to make the cuts very accurately. It is best to use the saw which is to be used with the miter box, but I have just filed my



Millions earn money with NICHOLSON FILES

HOLDING their own in a mechanical world, millions make money using Nicholson Files.

The money paid to men who use Nicholson Files undoubtedly is enough to buy the necessities of life for hundreds of families in this country—and some of the luxuries, too.

Millions use Nicholson Files because these tools have demonstrated again and again their capacity for removing the greatest amount of stock with the least effort on the user's part and at the lowest filing cost. Your hardware or mill supply dealer carries Nicholson Files.

NICHOLSON FILE COMPANY
Providence, R. I., U. S. A.

NICHOLSON
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A FILE FOR EVERY PURPOSE

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panel saw, so we can make the cuts with that."

Frank made the first cut with the utmost care.

"Bear in mind," he warned, "that you must never use anything but a sharp, smooth-cutting saw in a wooden miter box. Never force it. Let it run lightly or it may follow the grain of the wood and the cuts in the box will soon be destroyed."

"Why make the box so long?"

"Because when one cut becomes worn, others can be made as they are needed."

"I see. Well, now I have this miter box the rest will be easy sailing—or will it?" he added hastily as he noticed Frank's quick look of amusement.

"You may be in for a surprise party when you nail your first miter joint."

"It's not just driving nails, then?"

Instead of replying, Frank walked over to the scrap corner and selected a piece about the size of the screen stock. From this he cut four pieces in the new miter box, each with one mitered end.

"Now I want you to nail a miter joint together," he said, as he hung the saw on its peg. "Here is the vise, the hammer, and also some sixpenny finishing nails."

Russell rather awkwardly placed one piece upright in the vise with the mitered end several inches above the bench top and made several attempts to drive the nails. Neither the nails nor the wood seemed to behave themselves.

"Not so good," Russell confessed. "There must be a better way of doing it or the joint would not be used so commonly."

"There is," Frank assured him, as he picked up the other two mitered pieces. "First make one hole with a brad awl in the middle of one edge about three quarters of an inch from the end, and make two holes in the other piece. Notice that the single hole should go in straight while the two holes in the other piece slant in towards the center slightly to give the nails such a direction that they will not drive out of the side of the piece in the vise."

"I can see the need of that now," admitted Will.

Frank placed the piece with the single hole in it in the vise with the joint about level and quite close to the jaws to prevent any vibration. Then he entered two nails in the awl holes of the other piece and placed the mitered end on the piece in the vise.

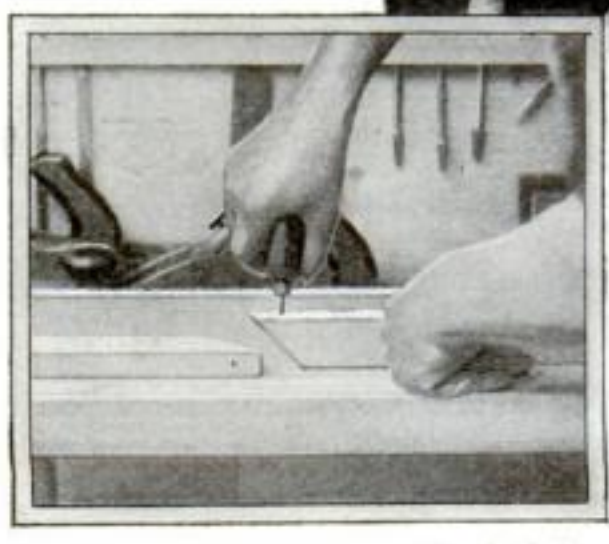
Picking up the hammer, he pointed out

Frank trued up the bottom piece by hand with his jointer plane and checked its squareness.

The square was placed so that the 8-in. mark coincided with the inside top edge of the back.

Marking the vertical cuts with the square standing on its edge.

"Not so good," confessed Russell after he tried to nail the mitered joint in this manner, which is far from being the right way.



It takes experience even to make the holes for starting the nails in a workmanlike way.

that the outer edge of the upper piece was set so that it extended ⅛ in. beyond the piece in the vise (as shown at the right).

"This is the real trick in nailing a miter joint of this sort," he continued. "The upper piece must be held firmly with its faces flush with those of the piece below. Drive one nail to draw the upper piece along the lower until both edges almost coincide. Drive the second nail nearly home; then drive both until the edges meet perfectly. Turn the joint around, placing the two-hole piece in the vise, and drive the single nail. When this is done, set all of the nails."

Russell had been watching carefully. "After all," was his comment, "the joint is about as simple as it looks when you go at it in the right way. After one or two attempts, I shall have no trouble."

"Be sure to nail the joints in proper sequence," Frank said. "Two diagonally opposite joints should be nailed first—one side and one end, each pair making an L. Place the one-hole piece of one L in the vise and drive the nails as in the single joint. You will have to be careful in handling the frame, or the joints already nailed will be racked. If that happens, usually setting the nails again will remedy it."

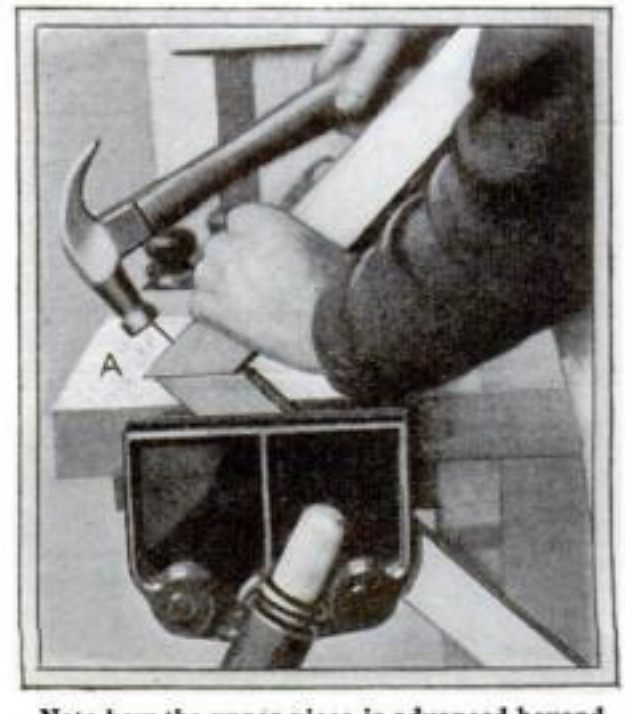
"I understand," said Russell. "Now, how is the middle crosspiece on the screen put in?"

"That should be squared off to the same length as the inside of the screen frame. Usually it is placed one inch above the center to cover the meeting rail of the upper sash and is fastened with tenpenny finishing nails driven carefully through the sides."

"I am certainly grateful," said Russell. "What I have learned tonight will hold me until I get to stretching the wire screening."

"Then come in again and I'll show you what little tricks I've found out about it," Frank promised as they said good-by.

Another story about Frank Bradley and his home workshop will be published in an early issue.



Note how the upper piece is advanced beyond the lower piece about ⅛ in. as shown at *A*.

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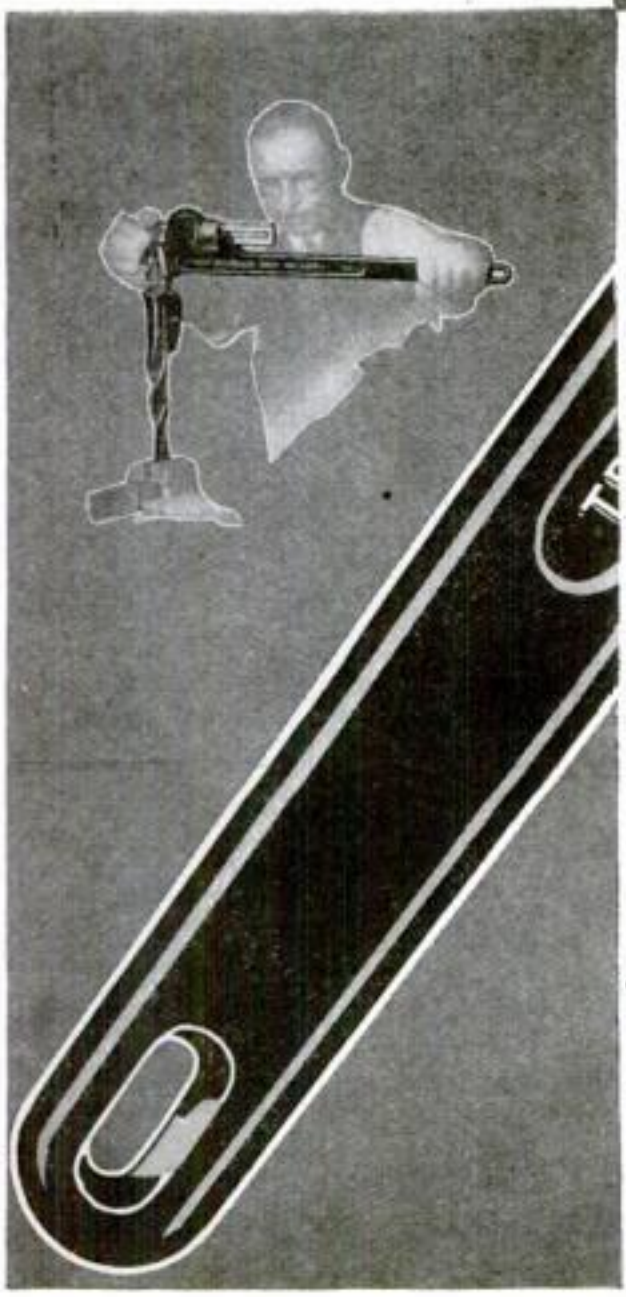

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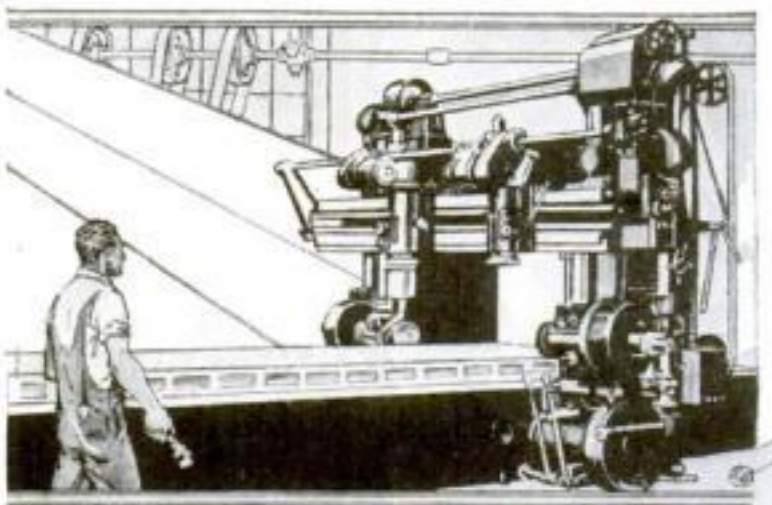
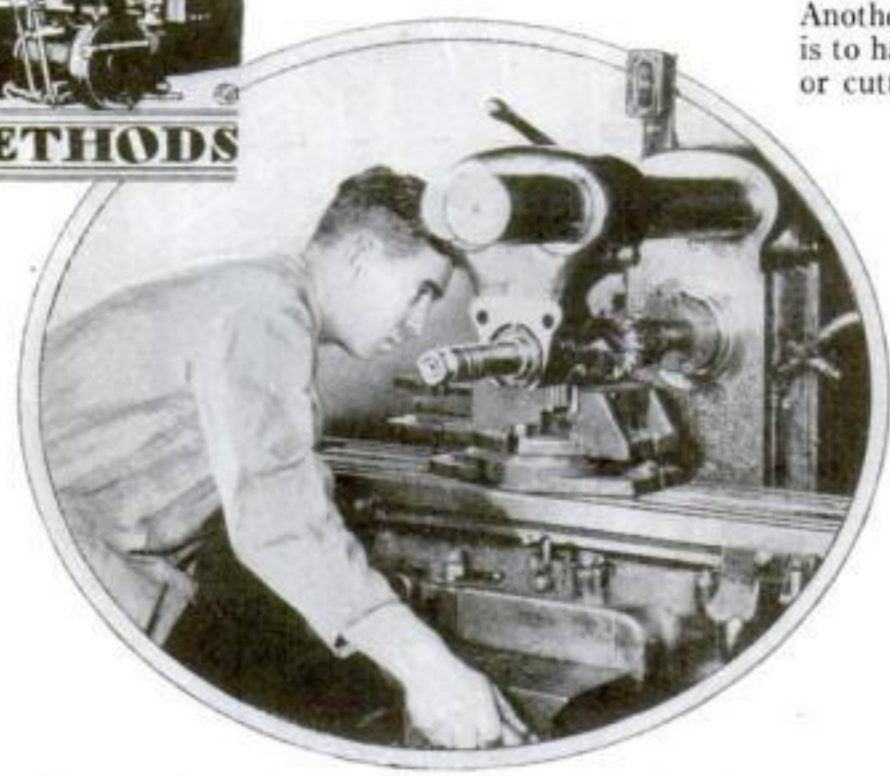
Hints on Blanking Sheet Metal



BETTER SHOP METHODS

How to save handwork and dodge die expense when making duplicate parts

By HENRY SIMON



In cases where only a few simple duplicate sheet metal parts are required, they can often be brought to shape on a milling machine.

WHILE a regular die is undoubtedly the best means of producing a shape in sheet metal, it is very costly if only a small number of parts—say anywhere from a few dozen to several hundred pieces—are to be made. Such small lots, indeed, often present difficult problems, for they are apt to be excessively costly whichever way they are made—too expensive as to time if made by hand, and too expensive as to tools if made under the press. There are, however, ways to sidestep any trouble by the judicious use of several methods, which we shall discuss in this article.

If the parts do not have to be extremely accurate as to shape and if the stock being used is fairly soft and moderately thick like those in the group of parts shown at *A* in Fig. 1, it is often possible to make a good cutting tool out of "shoe-die" steel. An example of such a die is shown at *B*. Shoe-die steel is a strip tool steel which has been supplied with a sharp knifelike edge similar to that shown at *C*. It is supplied by several makers in various forms. For our purposes, a good substitute can easily be made by grinding and filing a strip of ribbon tool steel or "ground flat stock" to the required shape.

A convenient way to mount such a die is to solder it to the flat face of an ordinary punch holder as at *D*, supplying it with one or more ejectors *a* made from rubber pads. The construction shown at *B* is advantageous mainly because it is cheaper and hence better suited, from a standpoint of expense, to larger shapes. How the rubber ejectors are made and fastened in place is shown at *E*.

With dies of this kind, leather, paper, thin hard fiber, asbestos, and other soft materials may be cut as well as sheet lead, thin copper, brass, and aluminum. Even tin foil and steel foil can be cut satisfactorily by this method if care is taken.

Where only a few pieces are needed, a die like that at *B* in Fig. 1 may be placed on the material by hand and used in a vise as at *A* in Fig. 2, or under a screw press as at *B*. For cutting very soft metals, the die may be left soft, but for anything harder than copper, it should be hardened and tempered to about a straw color. The pad under the material may be end-grain hardwood or thick, hard fiber for any material softer than copper, and cold rolled brass or steel for harder materials requiring a hardened die.

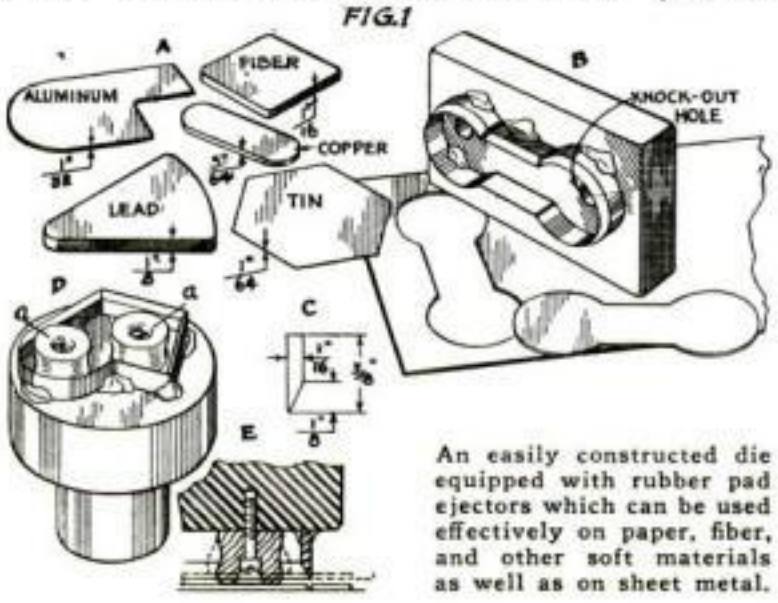
As indicated at *C* the edge must be sharper for softer metals and blunter for harder ones.

Another point that must be kept in mind is to have the bevel outside for "blanking" or cutting external shapes, and to have it inside for "punching," where the material punched out is the scrap and the part with the hole is the product, as is indicated by *D*. In cutting small circular shapes, like disks or washers, the same idea may be applied in a different form by turning a die from solid steel, like those shown at *E*. It may be added that for leather and fiber washers, a die of this kind is far better and usually cheaper in the end than many of the rotating and frequently dangerous "washer-cutters."

Where the material to be cut is both hard and fairly thick, it becomes necessary to find a different expedient. If only from a few pieces to a few dozen are needed, the work can be shaped by filing them between a pair of hardened templates as shown in Fig. 3. The simplest method of doing this kind of work is illustrated at *A*. The blanks, roughly cut and ground to shape by hand, are pinned together, or, if that is undesirable, fastened by "sweating" (soldering), as at *B*.

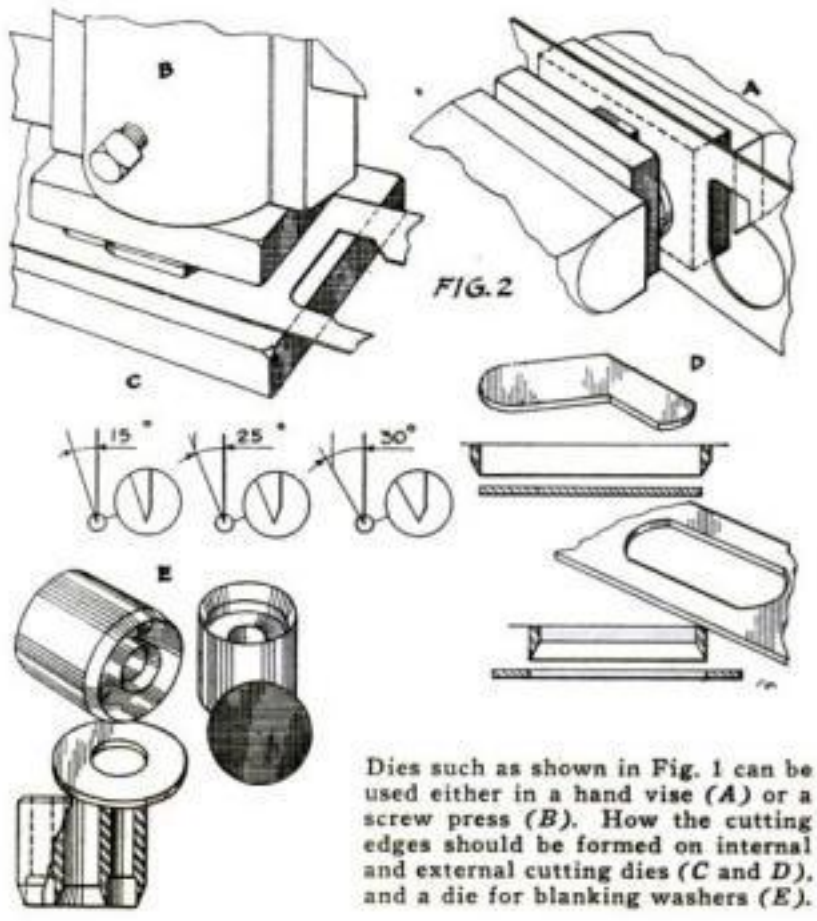
The templates *a* are either hardened tool steel or casehardened machine steel. By clamping the block in a vise and using alternate roughing and finishing files of different shapes and by working until the

FIG. 1

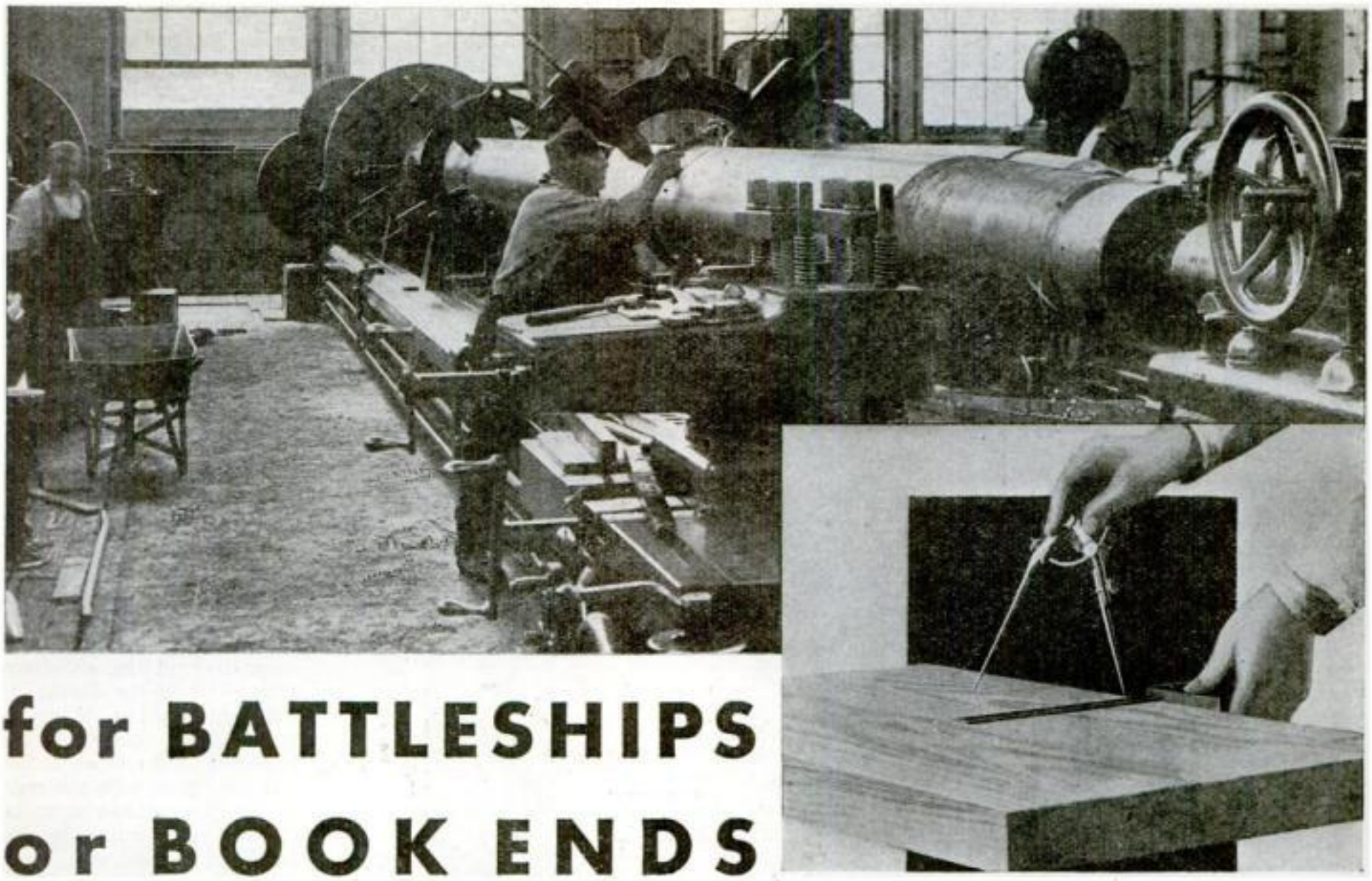


An easily constructed die equipped with rubber pad ejectors which can be used effectively on paper, fiber, and other soft materials as well as on sheet metal.

FIG. 2



Dies such as shown in Fig. 1 can be used either in a hand vise *(A)* or a screw press *(B)*. How the cutting edges should be formed on internal and external cutting dies *(C* and *D)*, and a die for blanking washers *(E)*.



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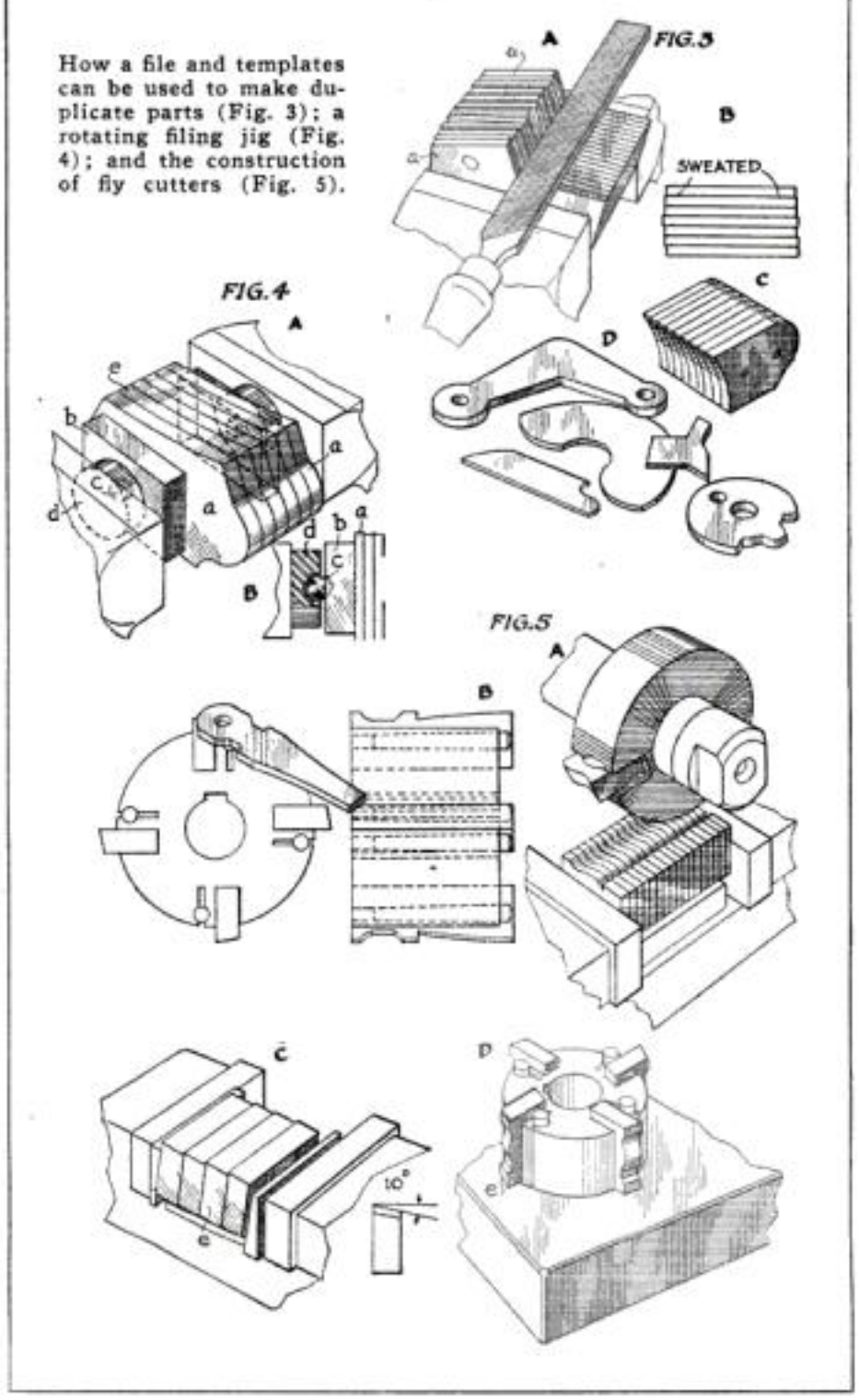
files start to slip on the templates, the mechanic can quickly bring the blanks between them to the exact shape, as indicated at *C*. Metal of any thickness may be shaped by this method to a great variety of forms, of which a few examples are suggested at *D*. Practically the only condition is that the final shape must be such that it can be held in the vise.

Other uses and modifications of the same method are illustrated in Fig. 4. A more convenient rig for filing, and one that avoids the necessity of soldering or pinning the blanks, is illustrated at *A*. Each template *a* is faced with a machine steel block *b*, which has a steel ball *c* forced into it. As shown at *B*, the ball revolves in a spot in a disk *d*, one of which is used against each vise jaw. The blanks *e* are held between the templates by the pressure of the vise. Partially releasing the pressure permits the entire jig to be revolved to any position for filing, after which it is locked in place again by tightening up on the vise. Quick work is possible with a jig of this kind, though care must be taken not to release the pressure too much until the parts are finished—unless, of course, they are pinned and soldered.

WHERE a considerable number of accurate parts from heavy material are to be made, it is often advantageous to mill them to shape with special fly-cutter tools as in Fig. 5. Though most mechanics are familiar with the use of fly cutters, such cutters are usually narrow affairs for producing a slot or small shapes. They may, however, be made of considerable width and used in the place of the regular form cutters. The cutter surface speed must not exceed that of ordinary milling cutters of the same steel, and only very light cuts and the very slowest speed of which the machine is capable should be used. Given these conditions, it is possible to do surprisingly good work with these tools.

The simplest form of cutter head is that shown at *A*. This has a single cutter blade which may be "sweated" in place by soldering. That shown at *B* is a four-cutter head with readily removable blades. The body is made from a block of machine steel in which the blades are clamped by means of tapered pins. It must be borne in mind that the taper pin holes must be completely finished to size before they are slotted.

How a file and templates can be used to make duplicate parts (Fig. 3); a rotating filing jig (Fig. 4); and the construction of fly cutters (Fig. 5).



HOW to form the cutter shape is demonstrated at *C*. The cutter blanks are given the required shape by milling or grinding while held between angle blocks as shown, the last operation being to mill the registering edge *e* while the blocks are still held together. When the cutters have been finished, hardened, and tempered, they are assembled with the registering edge against a surface plate as at *D*. Since the same head can be used with a large variety of blades, it is cheaper to make and have on hand a large variety of different forms.

Next month Mr. Simon will conclude this interesting discussion of simple methods for blanking sheet metal parts.

WHEN filing a long, slender piece of drill rod in the lathe, use two files, one on each side of the work, and grip them together lightly at the ends. Any spring is eliminated by this method.

Old Bill *Talks Shop*

AN EXCELLENT trammel can be made in an emergency by fitting the two clamping devices and scribers from two surface gages to a length of drill rod.

The night before is a good time to study and plan the next day's work.

Short headless cup set screws are good substitutes for transfer screws.

Always test a die shoe for squareness before mounting the die and the punch.

If you are using a lapping compound, keep your gage blocks out of the way.

When grinding in a surface grinder, never allow the work to become so hot that it cannot be touched with the back of the hand.

It is best to drill and ream a hole at the same setting.

Helical end mills, or ordinary end mills not having a center, can be ground on an ordinary tool grinder by building up the cutter ¼ in. thick on the ends with solder and centering it in a suitable collet.

When making small chisels out of drill rod, knurl them and they will be easier to handle.

MOUNTING BLUEPRINTS WITHOUT WRINKLES

WHEN shop prints or other much used blueprints are to be mounted on either wall board, wood, or other mounting boards, a smooth job without wrinkles is easy to obtain by this method:

Cut the mount large enough to leave the desired margins around the print. Lay the print on the mount, line it up, and draw a few guide lines around the edge. Now give the mount a heavy coat of shellac, taking care to keep within the guide lines. Then wet the blueprint until thoroughly limp, let the excess water run off, and lay it down on the still wet shellac on the mount. Take care that it is within the guide lines previously drawn so the margins will be straight and uniform. Smooth out any wrinkles, press the print into firm contact with the mount, and set it away to dry.

When both water and shellac are dry, the blueprint will be smooth and tightly stretched.—FRANK W. FULREADER.

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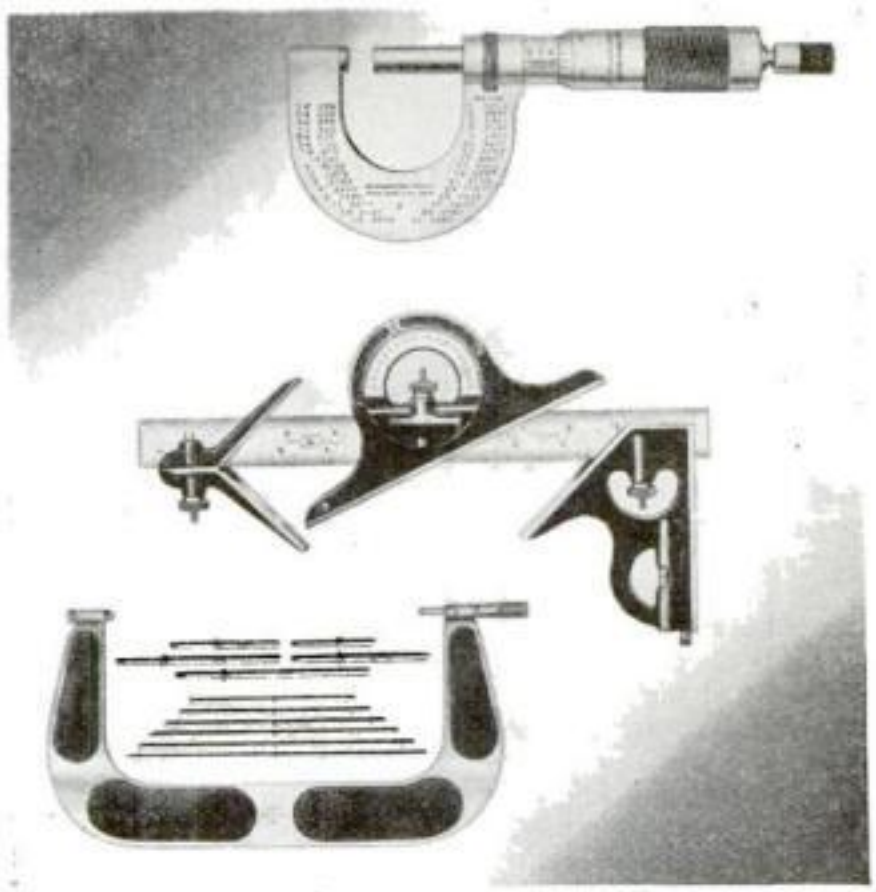

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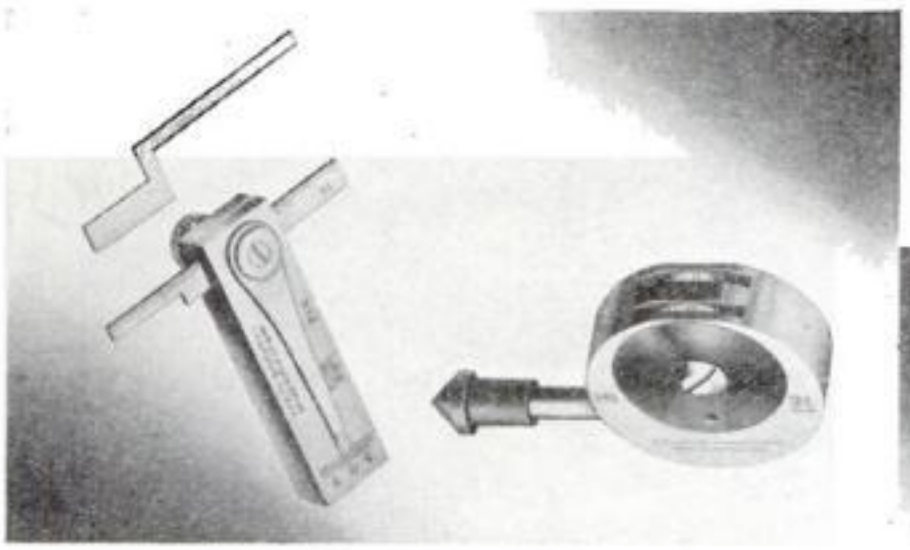

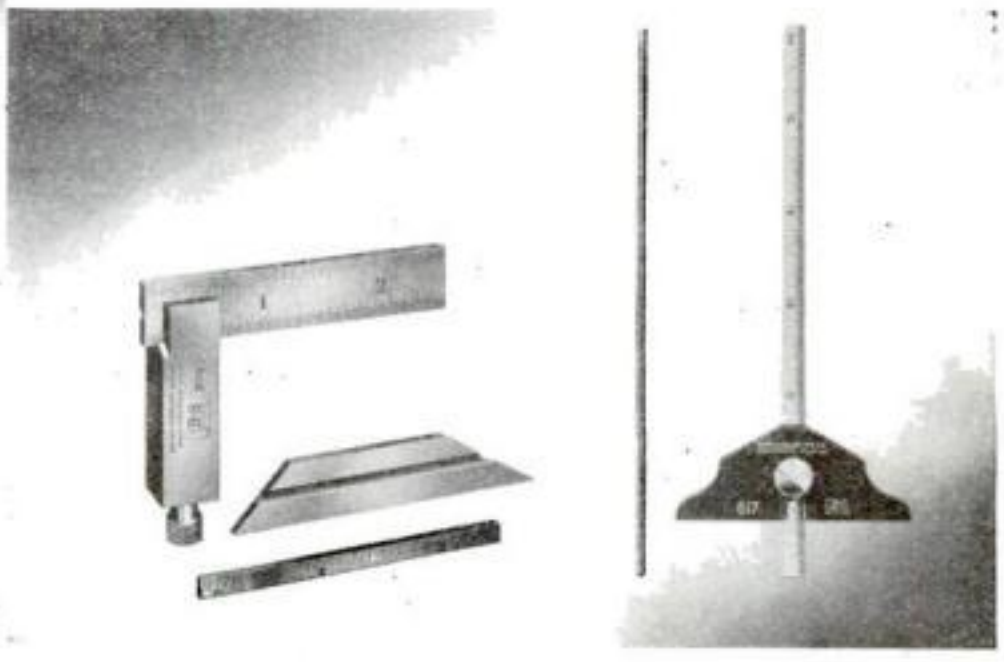

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Five Short Cuts for Machinists

Drilling, boring, gaging, and centering kinks; and an ingenious improvement for an ordinary V-block

MACHINISTS who are confronted with the task of drilling large holes in a number of pieces of thin metal stock will find that they can save time and turn out better work if they will make use of the following kink:

First sharpen the drill to be used according to the accompanying sketch (Fig. 1). With this drill make a conical depression in a piece of hardwood just deep enough to take the entire point of the drill, as illustrated. Next a small pilot hole is drilled in the work. The work is then centered over the depression in the wooden block, and both are held in a drill press vise.

When the drill is brought down on the work and the pressure is increased, the drill forces the metal into the depression in the wood before it starts to cut, and

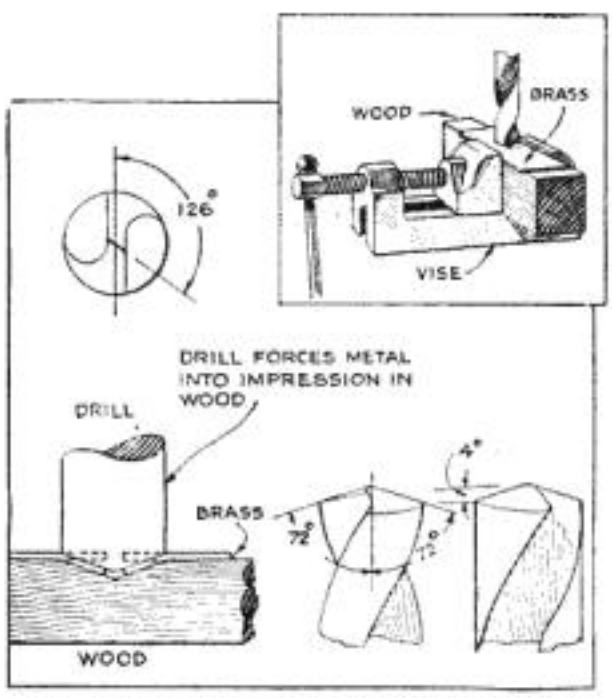

Fig. 1. A simple way to drill large holes in thin metal without distortion and chattering.

thus a guide is supplied for the drill point. As the pressure is increased, the drill will cut without the usual chatter.

The writer, who has used this kink many times, has found that he has been able to drill holes that were not more than .005 in. out of round.—THOMAS COOVER.

WHEN drilling or redrilling holes in round stock, the work can be greatly simplified if an ordinary V-block is equipped with the centering attachment as illustrated in Fig. 2. With this arrangement it is possible to set punch marks or drilled holes exactly in line with the vertical axis of the drill.

The center locating arm is made by bending a piece of strip steel as shown. This is then attached to two steel links.

When not in use, the centering attachment can be folded back out of the way by bringing the links forward in line with the block and swinging the center locating arm back until it fits snugly over the end of the V-block.—HARRY MOORE.

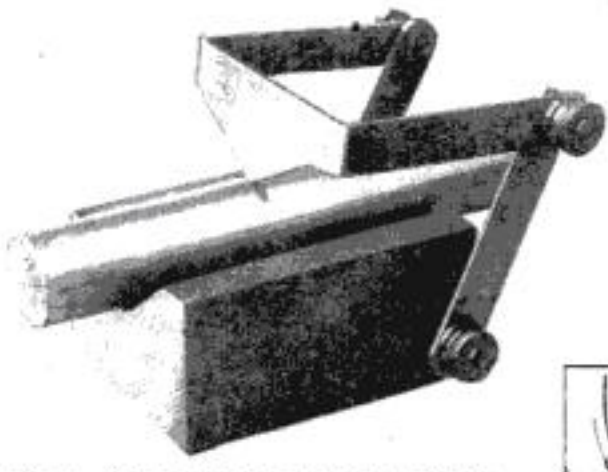

Fig. 2. V-block with centering attachment for setting work to be drilled.

WHERE production in either the machine shop or the pattern shop requires numerous concentric circles to be laid out on disks, flanges, and similar parts, the work can be speeded up if a circle-scribing gage like that shown in Fig. 3 is used.

The head of the gage is a brass casting while the movable shank is hardwood. The shank is held in the desired position by a small wing screw.

This type of gage can be used on both internal or external curves by setting the scriber point either beyond or behind the guide feet of the gage head.—W. LUTZENBERGER.

IN BORING holes with a noneccentric boring tool, considerable dexterity is required in moving the tool (shown at *A*, Fig. 4) the right amount in order to remove the last few thousandths of an inch. If a collar *B* with a hole out of center is placed as illustrated, the necessarily delicate adjustment for removing the last few thousandths is made by turning the screw *C*, which causes the boring bar *E* to spring the necessary amount.

It will surprise any mechanic who has not tried this kink what an accurate adjustment can be obtained.—CHARLES KUGLER.

FEELING that the usual method of centering duplicate work in the lathe was a needlessly slow and troublesome operation, the writer conceived the idea of a centering cap such as is illustrated in

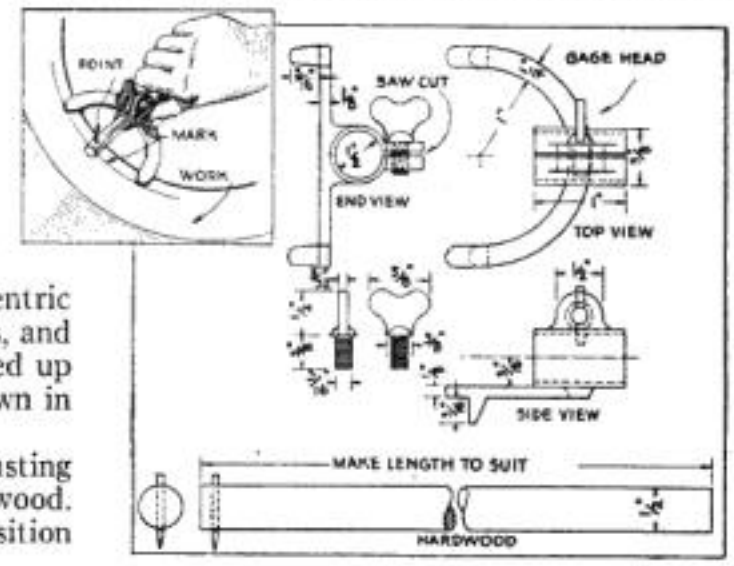

Fig. 3. An adjustable gage for scribing circular work.

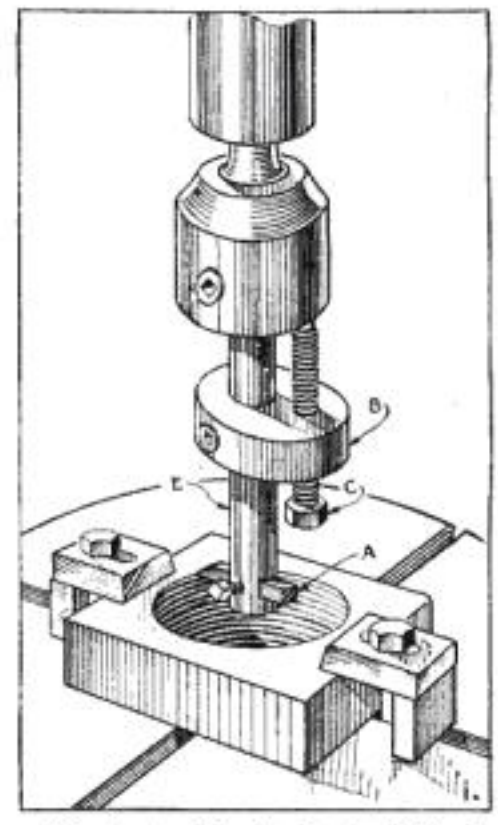

Fig. 4. A plain boring tool fitted with a screw for fine adjustment.

the drawings of Fig. 5.

With the cap in place, the work is centered in the drill press and later is faced on a half center in the lathe. The center drill is automatically centered by the hole in the cap made to fit the work. This method not only saves time but also materials, since the stock can be ordered to the exact size required and not from ⅛ to ¼ in. oversize to allow for centering. Another marked advantage is the facility with which work can be recentered if the original center becomes damaged.

Such a cap is equally useful for work that can be centered in a lathe collet. If the cap is slipped over the end of the work in the collet, the drill will not run out.—CLARENCE J. TURCOTTE.

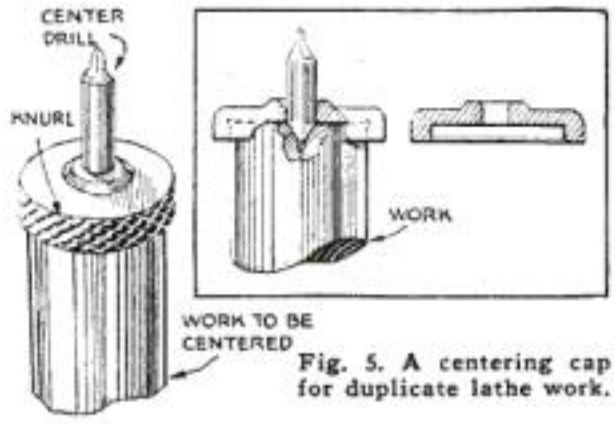

Fig. 5. A centering cap for duplicate lathe work.

THE dust caused by dressing a grinding wheel with a diamond is exceedingly harmful if inhaled. A mechanic, during the few seconds required for dressing a wheel, should hold his breath and then quickly step back while the cloud of dust settles down, which will take only from thirty to sixty seconds.—F. GLOWZEWSKI.

Inspector L. R. Rosenberger using a LUFKIN Depth Gage to check work on airplane carburetor jigs and dies at the Zenith Detroit Corporation.

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Photographed above is Inspector L. R. Rosenberger, of the Zenith Detroit Corporation, checking carburetor jigs and dies with a Lufkin Micrometer Depth Gage. Listen to what he says: "The care and accuracy with which Zenith Carburetors are made and inspected accounts for their excellent reputation. ***I use the Lufkin Depth Micrometer because the numbers can be read easily and quickly, and that's important. Also because it has a lock nut that keeps the reading fixed as long as you want it that way—something not found in any other Depth 'Mike'.***"

And there are other reasons for preference. ***The Lufkin Depth Micrometer is the only one with every thousandth numbered; the only one with top of base knurled, affording firmer grip in work.*** Each one is provided with three, sturdy, adjustable measuring rods, giving range from zero to 3 inches. This superior tool is typical of the Lufkin line of tools. (It is made with 3-inch base, known as No. 513; and 5-inch base, No. 515.)

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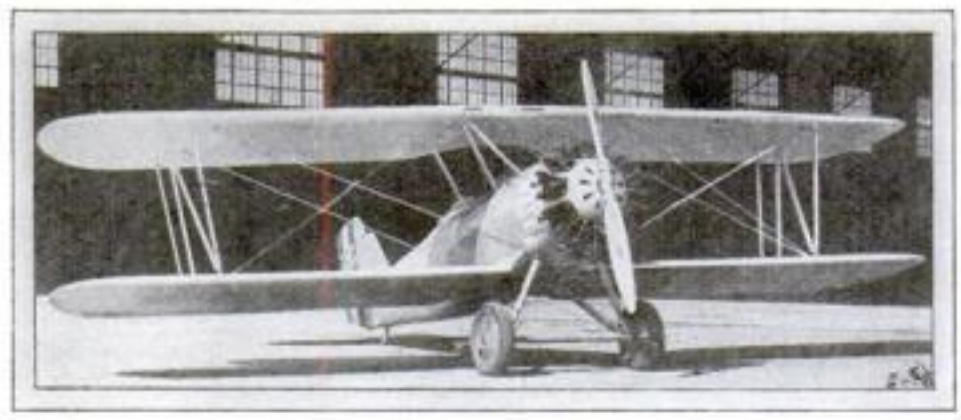


What could be a better subject for a model than the *Corsair*, one of those trim little pursuit planes now used so extensively by the U. S. Navy?

A Simplified Model of the Fighting *Corsair* Plane

By DONALD W. CLARK

EVERY airplane model maker has been tempted at some time or other to build a model of the Vought "Corsair," that well-designed, trim looking, and speedy American fighting plane used so extensively by the Navy. A realistic yet highly simplified model of it can be made by following the accompanying drawings, which were especially prepared for POPULAR SCIENCE MONTHLY readers.

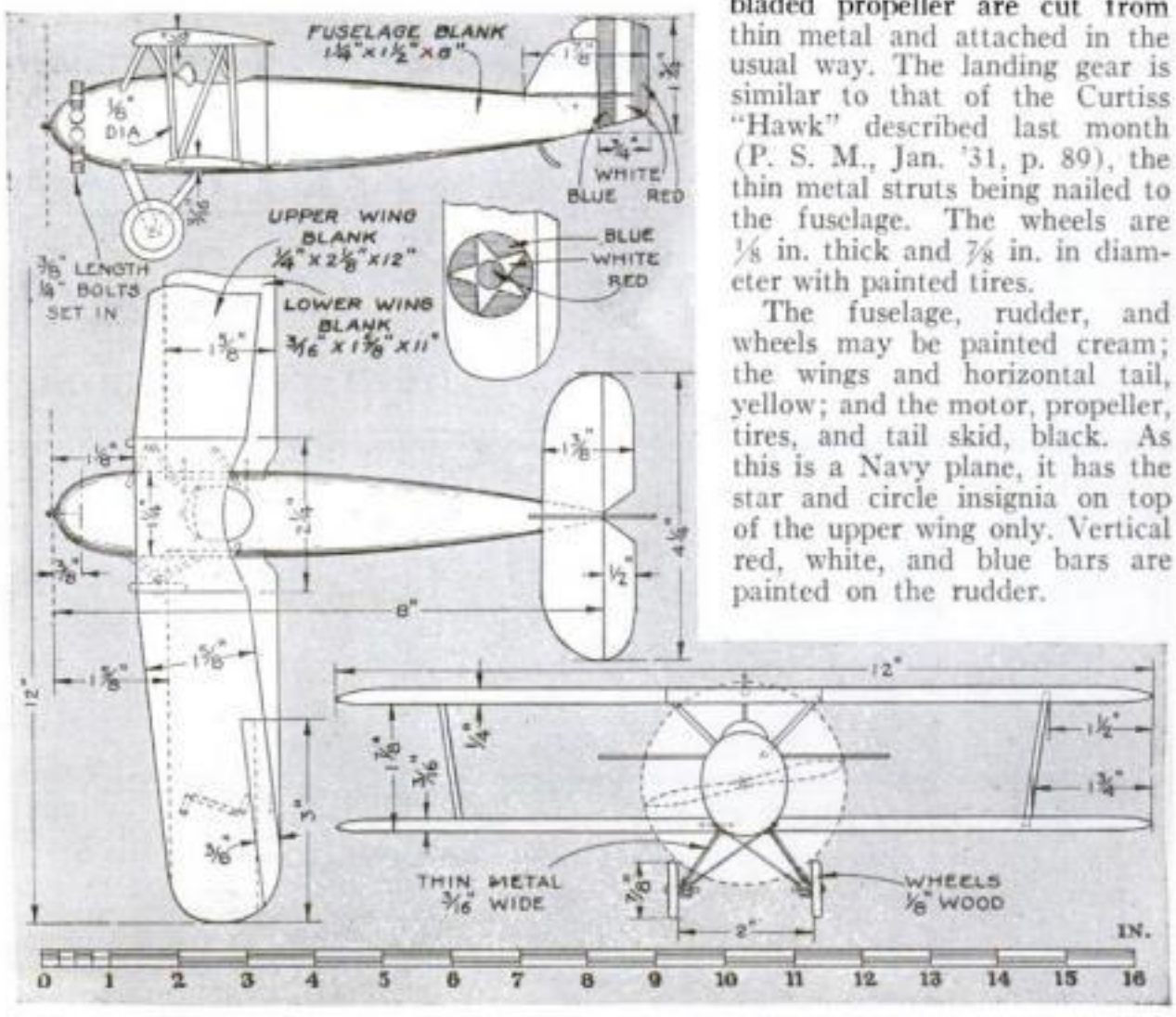
The fuselage is whittled from a block of wood 1¼ by 1½ by 8 in. The nine engine cylinders are represented by cutting ¼ in. diameter bolts into pieces ⅜ in. long and cementing them into shallow holes bored in the wood. A slot is sawed in the rear of the fuselage to receive the vertical tail unit, as shown by the dotted line in the side view.

The upper wing is cut from a blank ¼ by 2⅛ by 12 in., which is wide enough to allow for the sweepback. It is attached to the fuselage by means of six wooden struts ⅛ in. in diameter, each set into holes drilled at the correct angles into both fuselage and wing.

The lower wings are cut in one piece from a blank 3/16 by 1⅝ by 11 in. and then sawed in two. Each half is fastened to the fuselage with ½-in. wire pins. Before they are attached, however, it is necessary to drill the holes for the three ⅛-in. diameter struts on each side.

The tail units and 3-in. diameter two-bladed propeller are cut from thin metal and attached in the usual way. The landing gear is similar to that of the Curtiss "Hawk" described last month (P. S. M., Jan. '31, p. 89), the thin metal struts being nailed to the fuselage. The wheels are ⅛ in. thick and ⅞ in. in diameter with painted tires.

The fuselage, rudder, and wheels may be painted cream; the wings and horizontal tail, yellow; and the motor, propeller, tires, and tail skid, black. As this is a Navy plane, it has the star and circle insignia on top of the upper wing only. Vertical red, white, and blue bars are painted on the rudder.



Assembly views of the model and a detail showing the wing insignia. White pine or other soft wood and thin sheet metal are the only materials needed in the construction of this model.

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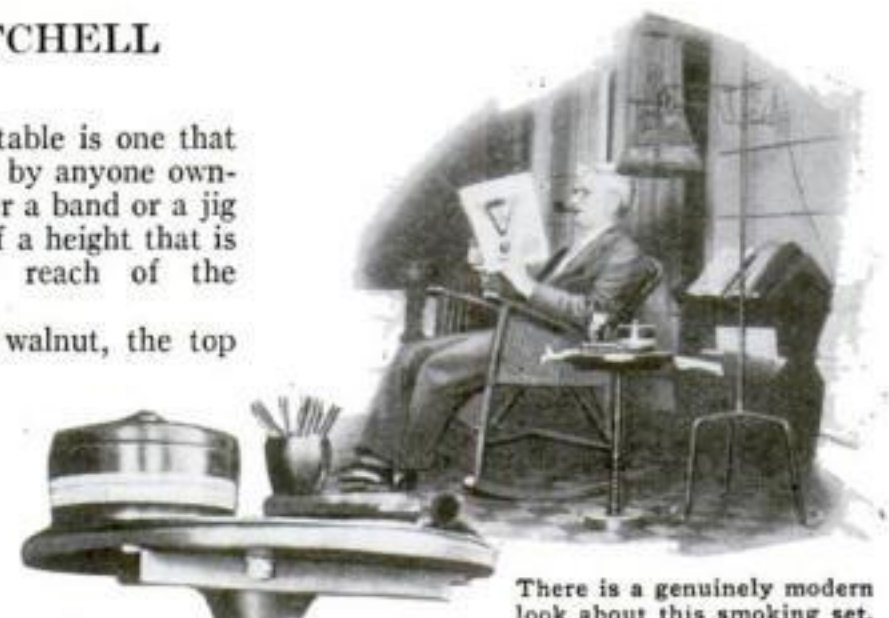
Pipe Smokers *Will* Appreciate *This* Table

By W. E. MITCHELL

THIS pipe smoker's table is one that may be easily made by anyone owning a lathe and either a band or a jig saw. It is compact and of a height that is within the comfortable reach of the smoker.

The one illustrated is walnut, the top and bottom being of wood from an old organ which was on its way to the city crematory when the writer paid an expressman a dollar to take it to his home workshop. In this organ there were many fine pieces of well-seasoned wood and three beautiful burl walnut panels. It seems a shame that wood as beautiful as this should ever be burned when there are so many craftsmen to use it. Woodworkers who make their wants known among piano dealers will find that they can pick up some very fine wood at a low cost.

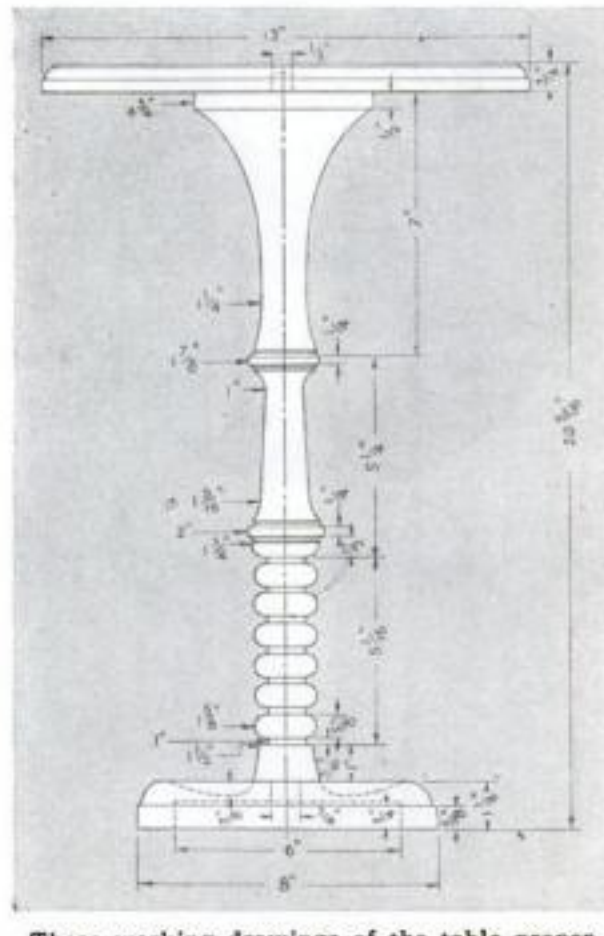


There is a genuinely modern look about this smoking set.

The top of the stand was made in two pieces, doweled and glued. The bottom piece had a ring glued to the underside and then was turned on the lathe. The ring was added for the purpose of providing a space to allow a piece of lead to be screwed on to steady the table and to keep it upright. The thick part of the spindle toward the top was made by gluing pieces 1 in. thick to all four sides of the stock.

Beneath the table is pivoted a receptacle for pipe cleaners. It is made of 1-in. square stock, hollowed out sufficiently to hold one package of cleaners.

The humidor (shown only in the photographs) is composed of two pieces of 1-in. walnut and one piece of 1-in. maple, glued and turned; it is 5 in. in diameter. The lid is made from ¾-in. stock. The whole can be turned in any design to suit the craftsman. If a piece of orange peel is placed in the humidor, it will keep the tobacco just right for a good smoke. On the underside of the lid of the humidor is fastened a strip of abrasive material on which to strike the safety matches. Nothing excels a match for reliability in pipe smoking.



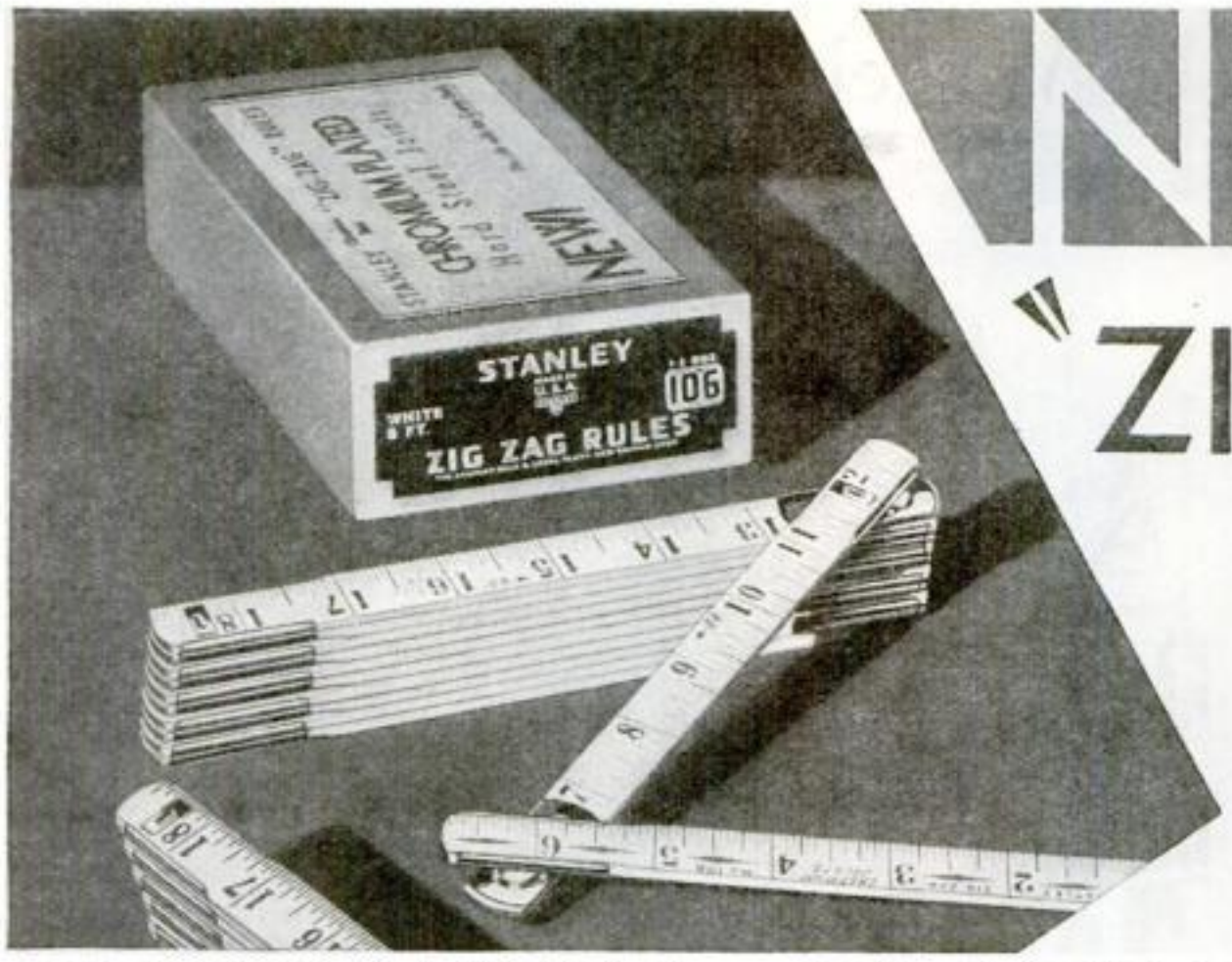
These working drawings of the table proper show clearly the originality of the design.

The ash tray, which is 4 in. in diameter, is turned from 1-in. stock. The special feature of the tray is a high center for knocking the ashes from the pipe into the tray; any pipe smoker will appreciate this convenience. The match holder can be turned from waste stock.

A paste wood filler and three coats of varnish were applied to the stand and the other pieces. Each coat, except the last, was sanded with a fine grained garnet paper; the last coat of varnish was rubbed with powdered pumice stone and oil.

MAKING GROUND GLASSES

THOSE who are particular about the ground glass in the focusing panel of their cameras can grind a much smoother piece than ordinarily can be purchased. Sprinkle a little very fine emery dust or other abrasive on the glass and add enough water to make a thin paste. Then do the grinding with a block of wood to which a piece of sheet copper about 3 by 5 in. has been tacked. Use circular motions and take care not to break bits of glass from the edges.—FRED H. ENGLISH.



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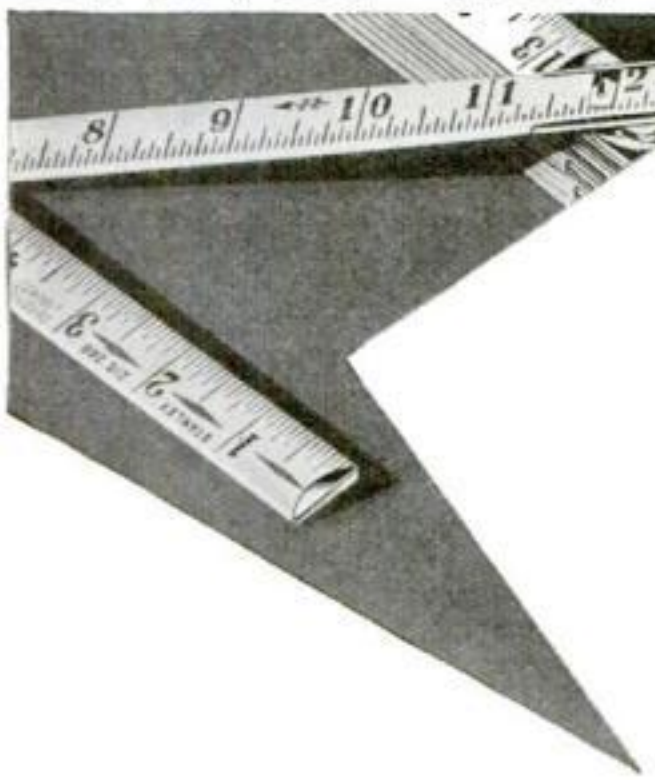

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A Wheel for Making Pottery

By HAROLD L. McCONAUGHY

This simple but efficient potter's wheel can be made from junk-yard materials at low cost.

THOSE who wish to experiment in making pottery—that old and fascinating craft which is far too much neglected by amateurs—will find it possible to construct an inexpensive but highly effective potter's wheel by using the method shown in the accompanying drawing. This set-up will provide many hours of pleasure for anyone who wishes to learn the art of pottery.

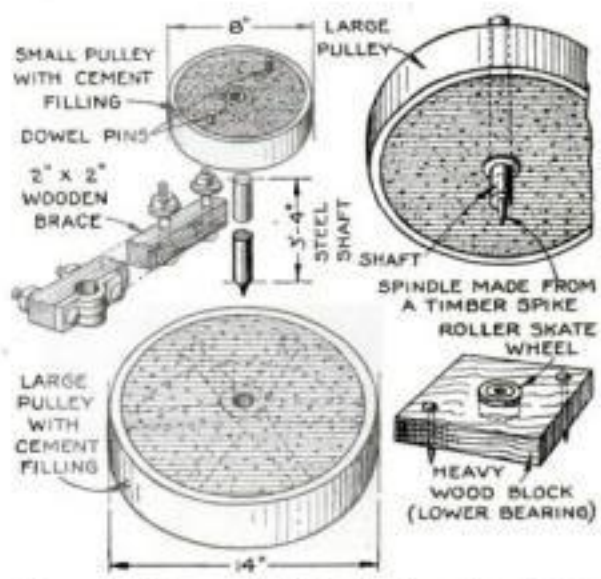
My own wheel is about 8 in. in diameter at the top, while the flywheel at the bottom measures 14 in. The latter might well be still heavier. However, with one vigorous kick from a soft-soled or rubber shoe, the wheel will spin from fifty to one hundred times.

Both wheels, which are old pulleys of the set screw type purchased at a junk yard, are first fitted to the shaft 30 in. apart and are then filled solidly with a rich mixture of cement and sand. Two short dowel sticks of large diameter are embedded in the cement of the top wheel; these engage holes in the plaster of Paris cap, which is later added to serve as the working top of the wheel.

Since the shaft I used had a small threaded hole in its end, I merely cut off a large timber spike and bedded the blunt end in the threaded hole by means of iron cement. The spike was allowed to protrude, and its sharp end fits into the end thrust bearing. This is merely a heavy block of wood with a ball bearing roller skate wheel sunk tightly into a hole in the top surface. Two spikes are driven through the block in diagonally opposite corners, and the points fit into small depressions chiseled in the basement floor.

The shaft should be set up at the extreme right-hand end of the workbench. The upper bearing is made by bolting a 2 by 2 in. wooden brace under the bench top (so that the wheel will be demountable), cutting a semicircular notch in it to receive the shaft, and fastening a pipe strap to it with two small bolts as shown. Although this is a crude type of bearing, it is satisfactory if kept well greased.

Plaster of Paris caps, upon which the clay is placed, can be made by wrapping a piece of linoleum around the top wheel to form a rim, tying it in place with a strap or rope, and pouring a mixture of plaster and water into the basin thus formed. The plaster should be from 1½ to 2 in. thick.

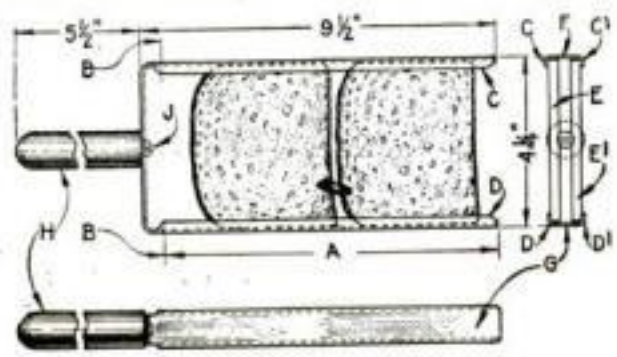


The wheel is assembled by locking two pulleys on a shaft and weighting them with concrete.

TOASTER MADE FROM CURTAIN ROD

BECAUSE the toaster illustrated can be used over gas and coal stoves, it is especially suited for camp use and wherever electricity is not available. It requires only one piece of flat metal curtain rod and a short piece of broomstick.

The flange members *C*, *C*¹, and *D*, *D*¹, are bent out at right angles to the main portion of the stock *F* and *G*, but only for the distance marked *A* on either side. For the remainder of the distance, marked *B*, the flange is bent down close to the parts *F* and *G*. The broomstick handle *H* is fastened to the holder with a round-headed wood screw *J*.—R. R. RENDULL.



The top, side, and end views of the toaster.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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Price 25 cents each except where otherwise noted

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We Finish the Deck Fittings on Our Destroyer Model

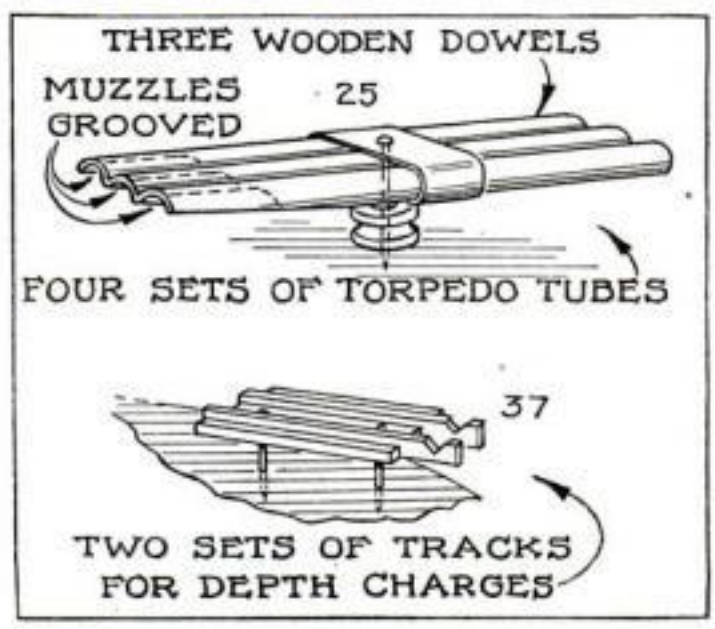
By CAPT. E. ARMITAGE McCANN

WITH only a few of the deck fittings yet to be placed, our destroyer model begins to take on the trim and speedy appearance of its larger prototype, the U. S. S. *Preston*.

The work of building this 31½-in. model can be simplified greatly through the use of the full size plans which appear on Blueprints Nos. 125, 126, and 127. These blueprints, together with an enlarging scale for use in building a 47¼-in. sailing model, can be obtained from the POPULAR SCIENCE MONTHLY Blueprint Service Department for seventy-five cents (see list, page 117).

Abaft the galley on the starboard side of the deck is a whaleboat *33*. This can be hollowed out from softwood. At each end is a staple for the lowering tackle, which is rigged from davits made from No. 18 brass wire. Lashed to the davits, below the gunwale level of the whaleboat, is a boat spar or strong-back. A guy starts at a staple in the galley deck, fastens the tops of the whaleboat davits, and extends to the davits for the motor-sailing launch. The whaleboat is hung by tackles consisting of two double blocks each and is held fast to the strong-back with two lines, which run from the guy between the davits to a staple in the deck under the strong-back.

On the same side of the deck is a 24-ft. motor-sailing launch *34*. The davits for this and the 21-ft. dory on the opposite side of the deck are of girder-iron. I imitated these by bending a piece of square brass rod to shape. They can be fastened to the deck by filing the lower ends to a point and driving them in.



Details showing the construction of the sets of torpedo tubes *(25)* and the tracks for depth charges *(37)*.

The 21-ft. dory also is hollowed from wood and has a cowl over its fore end. Nested in this is a 10-ft. punt *36*.

With the deck in this stage of completion, it will be well to make and

attach the remaining ventilators as shown in the deck plan (see P.S.M., Feb. '31, p. 90).

As the destroyer is just an elaboration of the older torpedo boat, it is equipped with four sets of torpedo tubes. These I made from dowels, by beveling and hollowing the muzzle ends as shown in detail *25*. The back ends are round, and a bent pin is driven into the butt of each to represent the handles on the loading breech. These dowels are glued and lightly nailed together in sets of three. Around the middle of each set, a piece of paper is glued, and a pin is driven through the center tube and used to fasten the entire set to the deck. The bases can be turned or cut from softwood.

Abaft the after deck house is a watertight hatch and a 3-in. anti-aircraft gun, which is shown in detail *32* (see P.S.M., Feb. '31, p. 92).

RIGHT at the stern, projecting over the edge of the deck, are two tracks *37* for the dropping of depth charges. I made the tracks, platforms, and retaining wedges from one piece of wood and set them on pins for legs.

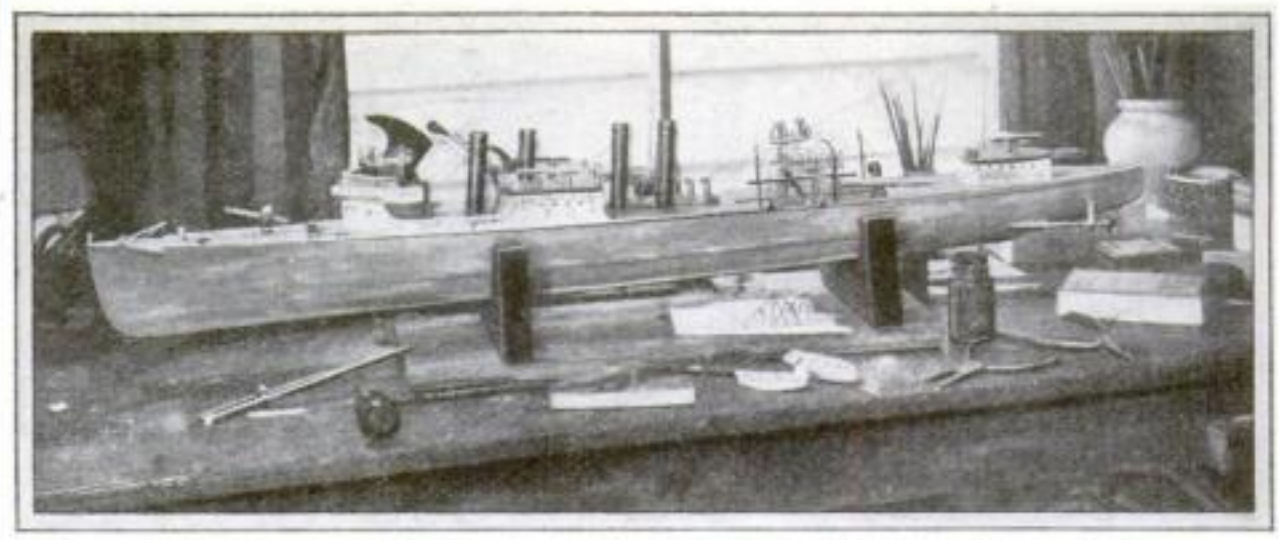
At intervals along the edge of the deck are bollards and open and closed cleats for leading mooring lines. The former, on a small model such as this, can be escutcheon pins driven in at a slight angle, and the cleats may be shaped from boxwood, celluloid, or brass. For larger models, brass or white metal bollards and cleats can be cast, if desired.

Along the forward section of the deck there are six one-ball stanchions. The forward end of the rail, which should be of chain, is fastened to a ring around the jack staff.

THREE-BALL stanchions are used along the remaining portions of the deck excepting in the well deck and where the torpedo tubes swing out. If the deck is to be removable, a stanchion should be placed on each side of the two joints. On the original destroyer, cross lacing ran from a jackstay along the edge of the deck to the middle rail, but for the sake of simplicity—and since there will be no crew on my model to be washed overboard—I have omitted this detail, as well as the awning stanchions.

Now we have only the masts left to make. The foremast (page 121) is comprised of lowermast and topmast. Just above the bridge deck on the foremast is a band with belaying pins. This can be made from thin wire twisted to form small loops to hold the belaying pins. Just above this is a bell hung on the afterside of the mast. This can be cast from lead or filed from brass rod. Halfway up is the navigation light *43*, made from two clear glass beads with a pin passed through them and riveted to a brass platform.

Higher up, and abaft, are the two man-o'-war lights *44*, simulated by glass beads placed on bent wires which are driven into the mast. The gaff *40B* has a halliard and a signal halliard at the outer end. The crosstree is a piece of wire drilled at the ends to take the breast stays. Three signal halliard blocks are fastened on each side of the crosstree; for these I used very tiny beads. Silk halliards should be rove



The work of placing the deck fittings can be greatly simplified if the model is placed in some sort of a stand. Full size drawings of this model appear on Blueprints Nos. 125, 126, and 127.

through the blocks and belayed at the mast, or to the signal rail if they are signal halliards.

The yard near the top can be of wood. This has similar blocks, four battle lights, and two blinker lights at the ends. These are very small, clear beads set on pins. Above this is a spider band with three eyes; and above is another with two eyes. On the extreme top of the mast are set two clear beads to represent a masthead light.

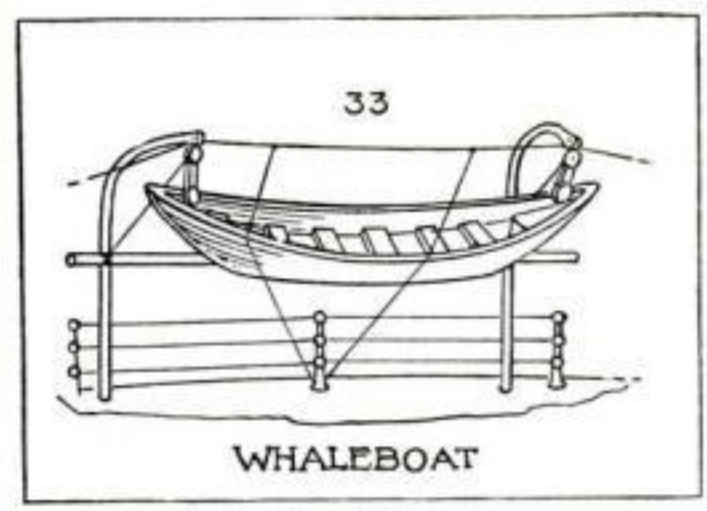
The crow's nest can be made of wood with the cover set on three pin points, the whole being fastened with brads to the mast. The afterpart, below, should be gouged out slightly to fit the mast, allowing the crow's nest to set upright on the trestletrees. These trestletrees I made of brass and supplied with wire supports, which were soldered to the trestletrees on one end and driven into the mast on the lower end.

A Jacob's ladder leads to the crow's nest. In reality this is a very light affair made of iron bars. I made mine of thread and painted it black.

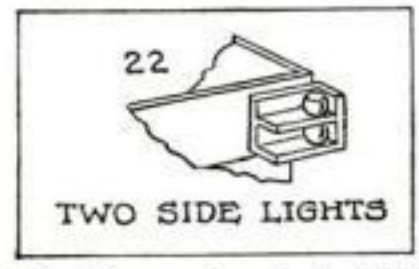
From the mast, two backstays *47* lead to the bolts in the foreside of the galley, two breast stays *48* lead to the bolts abaft the bridge, and two forestays *49* lead to the foredeck. There is also a longer forestay running to the bow towing cleat. If the deck is to be taken up, this should be supplied with a hook at the deck end so that is can be removed easily.

The after- or stub-mast on a real destroyer is hinged at the deck so that it can be lowered out of the way, but on the model I fastened it in place permanently.

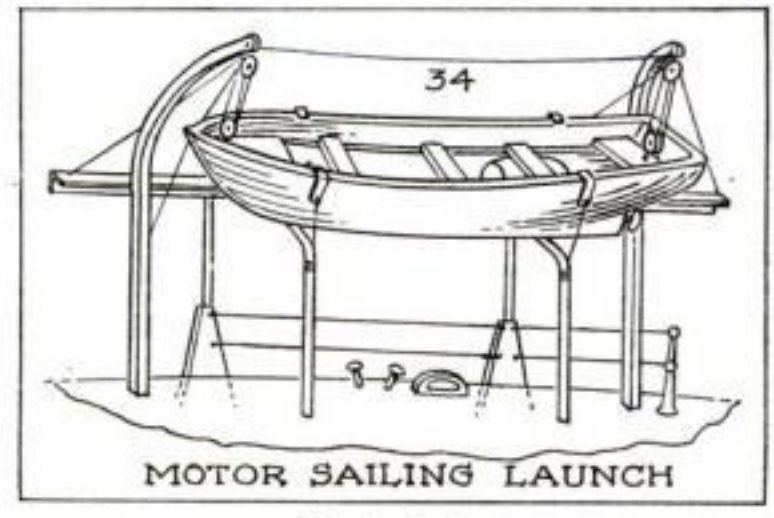
Stretched between the masts is the radio antenna made from four strands of No. 32 silk-covered magnet wire, from which the silk has been removed. These are stretched and soldered to wire bars or spreaders, which in turn are fastened by two stays to an eye at each masthead. Four glass beads are used to represent each insula-



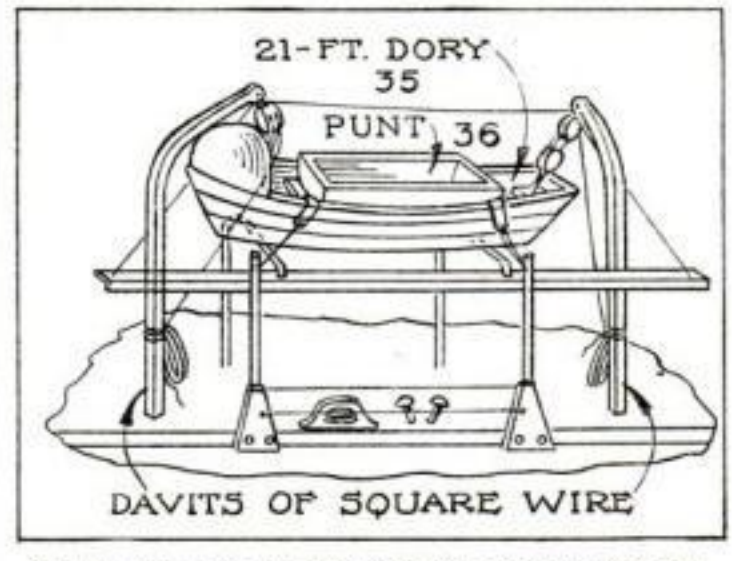
Perspective sketch of the whaleboat *(33)*, which is placed directly aft of the galley on the starboard side.



Red and green glass beads held in place with pins are used to simulate the pairs of side lights *(22)*.



Sketch of the motor launch *(34)*, which is also on the starboard side.

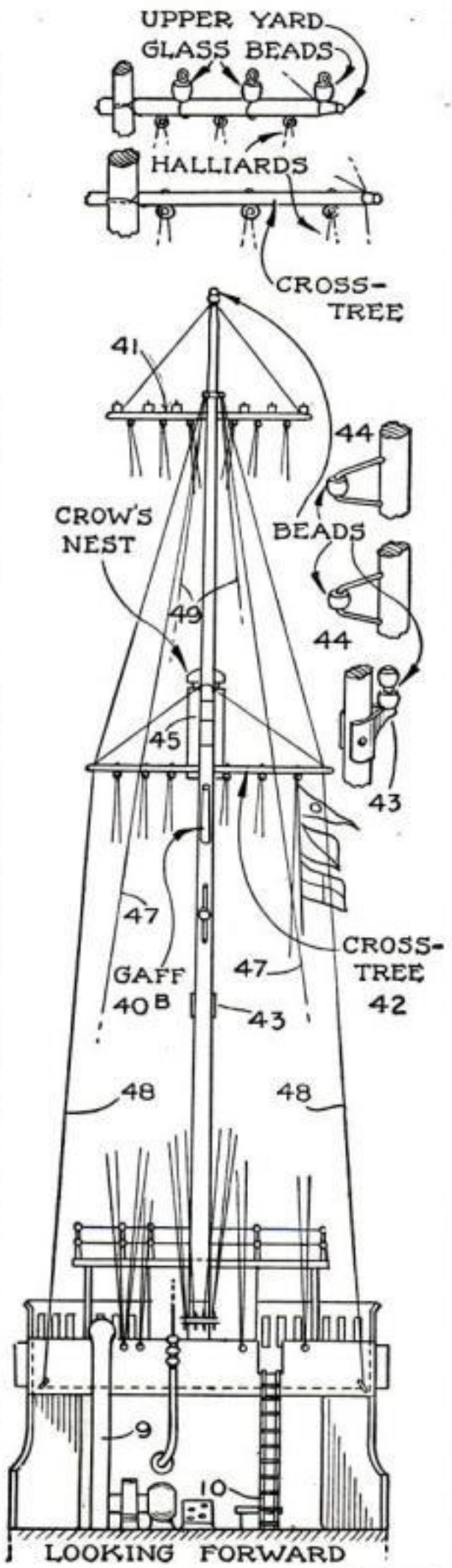


On the port side of the model is the dory *(35)* and nested in it is a punt *(36)*. Note cleat and bollards.

tor. The ends of the four antenna wires at the foremast come together and are joined to a thicker wire, which continues down to a guard leading to the radio room.

The entire model should be painted a uniform gray, excepting the life rings, brass work on the navigation bridge, halliards, and antenna wires. The vessel's number, in white shaded with black, appears on both sides of bow and stern. The name *Preston* appears on the stern.

Some readers have asked for suggestions on camouflaging the model. These will be published next month.

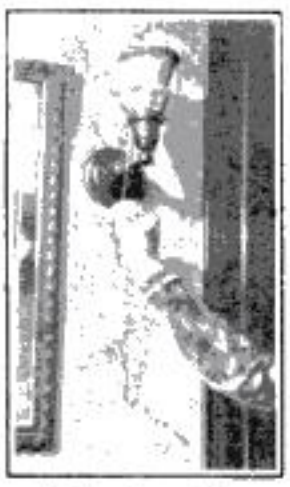


Rear view of the foremast and well deck and details showing points in the construction.

Ingenious Electric Fittings *for the* Handy Man

By HAROLD P. STRAND

SUCH electrical jobs as the handy man is called upon to do about the house can be frequently made easier if full advantage is taken of the numerous ingenious fittings which are now on the market. Professional electricians, who have all sorts of supply catalogues at their disposal, are familiar with a great many conveniences of which the amateur has never heard. Some were described in four previous articles (P.S.M., Mar. '30, p. 120; Apr. '30, p. 118; May '30, p. 122; and June '30, p. 107). Others will be described in this and in several articles scheduled to follow from time to time in forthcoming issues of this magazine.



A dimming socket in use in a hall.

What is the most convenient way to reduce the current flowing to an electric light so as to give less illumination, and to control the heat of electric pads and other appliances?

By using a special dimming socket or plug. Several types are available, three of which are shown at *A*, *B*, and *C* in Fig. 1. *A* is a combination pull socket and dimmer, which is connected in exactly the same way as an ordinary electric light socket. It has two chains, one of which is pulled to dim the light and the other to increase it. The lowest point of the control dims the light to a degree suitable for a night light; at the maximum position, the lamp burns with full brilliancy.

If preferred, a socket may be obtained with a screw base to fit in the existing socket without change, the only difference being that the bulb hangs in a slightly lowered position owing to the extra socket and therefore may not be so well shaded. This supplementary socket is shown at *B*.

A special dimming plug is also supplied for controlling the heat of electric pads, the speed of fans, the operation of vibrators, and other uses. This plug, which is shown at *C*, is screwed into any light socket, and the cord from the appliance is then screwed into the plug.

Can the temperature of an aquarium be fixed and maintained by electricity?

A new electric heater for this purpose is supplied in five sizes (*D*, Fig. 1). A thermostat, which is built into the device, automatically keeps the water at a fixed degree. All current-carrying parts are insulated and shielded, and the heater comes equipped with a 6-ft. cord and plug for connection to any 110-volt supply.

What is a convenient and durable type of switch to control the small motors of the home workshop?

A new toggle-type, 20-ampere switch, combined with a pressed steel connection box, is available for this purpose (*E*, Fig. 1). It is a rugged, heavy-duty switch of double-pole construction, and makes the control of the shop motors very easy.

What is the latest method of obtaining a candlelight effect in an electric fixture?

By the use of the electric candle lamp pictured at *F*, Fig. 1. It is about 7 in. long and 1⅛ in. in diameter, with a standard Edison screw base. Luminous for its full length and giving a soft, mellow light, it is desirable for candlesticks, torches, and special fixtures where a unique candle effect is desired.

How can the theft of lamps in public halls, apartment houses, and such places be prevented?

By installing one of the special lock sockets which require a key to allow the

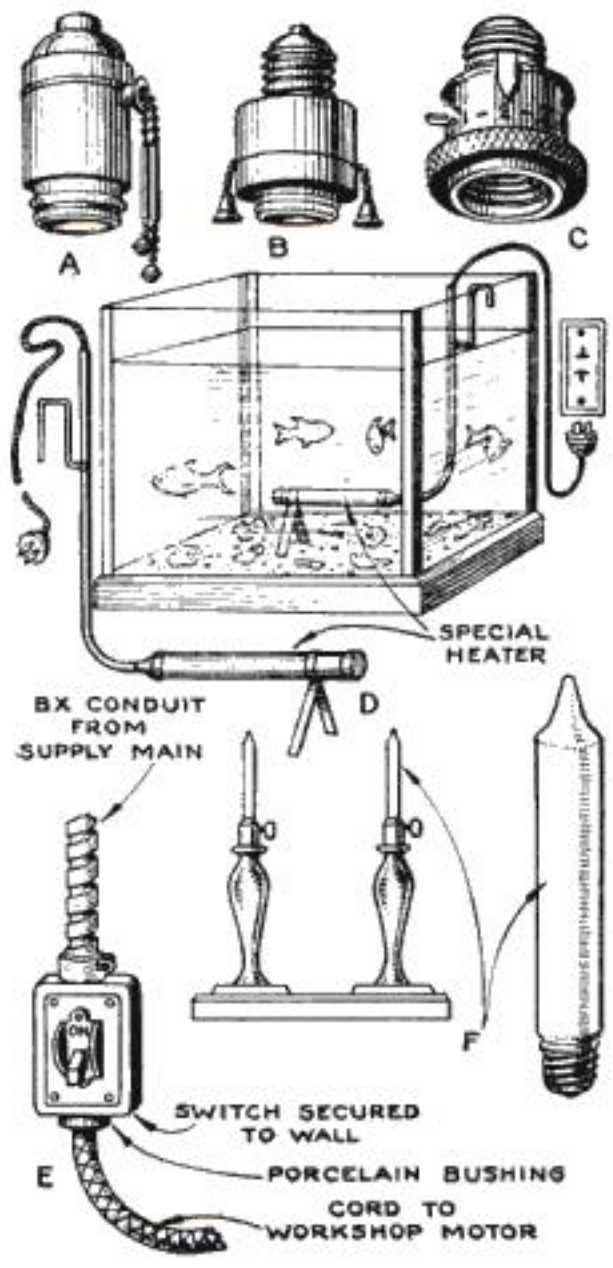


Fig. 1. Current-controlling sockets, heater for aquarium, motor switch, and candle lamps.

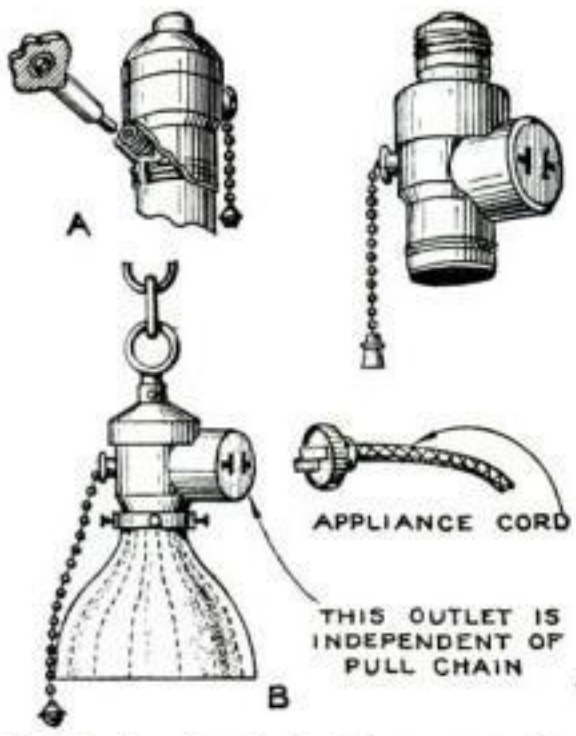


Fig. 2. A socket designed to prevent the theft of lamps, and two current-tap sockets.

removal of the bulbs. Figure 2 at *A* shows a pull socket of this variety. It has a pointed plug that is turned into the lamp base, holding it immovable. The precaution must be taken in installing this type of socket to see that the ground or dead side of the wiring circuit is connected to the shell or outside connection of the socket, as required by the *National Electric Code*. This brings the live side up on the center contact, away from possible trouble.

How can a cord for an appliance be connected to a fixture without using the customary two-way socket?

There is a "current tap socket" designed for this use (*B* Fig. 2); it is substituted for the existing fixture socket. Built into its side is a plug outlet, which is independent of the pull chain which controls only the lamp in the shade. For kitchens where no iron receptacle is installed, as well as

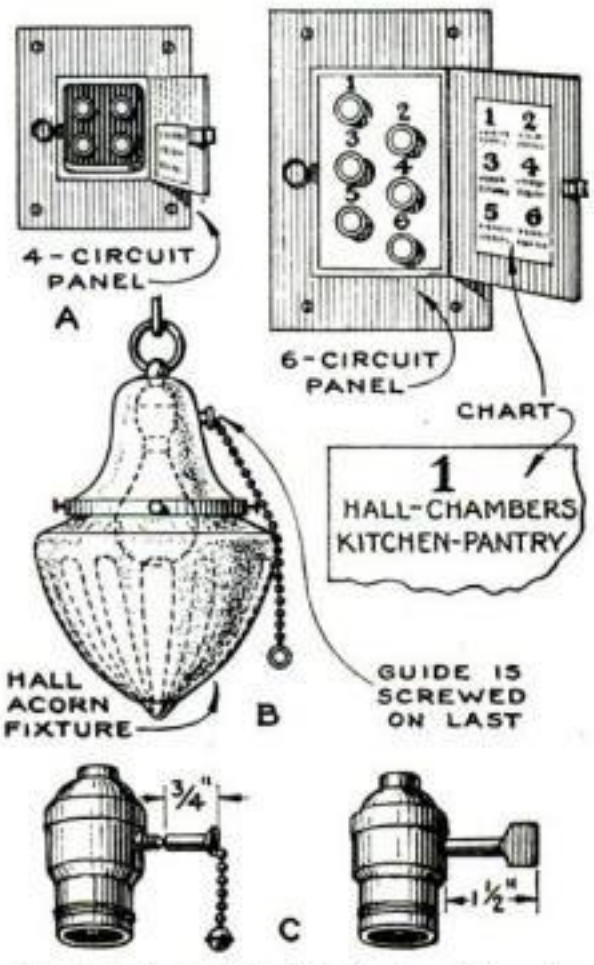


Fig. 3. Convenient hall fuse-panel boards, an extension chain guide, and a long key.

in bedrooms or, in fact, anywhere that an attachment is needed, the socket will be found useful and practical. If one desires, the same type of socket may be obtained with a screw base (also illustrated in Fig. 2) to fit in the existing socket without change.

Where is the most convenient location to place the fuses for house circuits?

It is now possible to obtain very compact and neatly designed flush-type fuse-panel boards, as shown at *A*, Fig 3. If one of these is installed in the wall in a hall or other accessible place, the changing of fuses becomes an easy task when a blow-out occurs. A chart pasted on the door on the inside, with numbers corresponding with the fuses in the panel, tells which fuse controls the circuit in question.

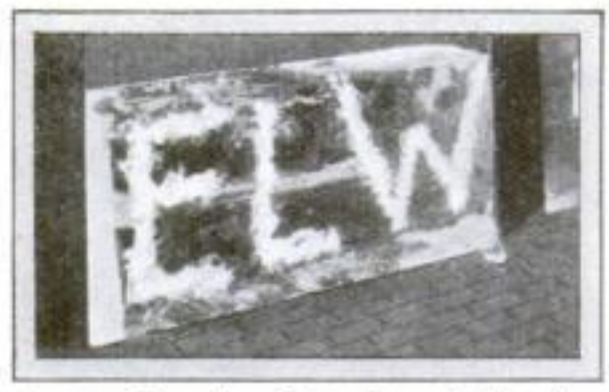
How can the unsatisfactory operation of a pull socket be overcome when it is used with a wide socket cover like that sketched at B in Fig. 3?

Pull-chain sockets are supplied with extra long guides (*B* and *C*, Fig. 3) to carry the bead chain out far enough to clear the edge of the cover. Such a guide allows the chain to be pulled easily and smoothly. Key sockets with extra long keys (also shown at *C*, Fig. 3) are obtainable for the same purpose.

LARGE ICE CAKE MAKES NOVEL ELECTRIC SIGN

A CAKE of ice can be converted easily and inexpensively into an illuminated sign, either for advertising purposes or as a novel decoration for any evening event outdoors.

The block of ice is set up on edge and the lettering or design is marked on the front face by chipping the ice with a small hammer, ice pick, or other tool. Then one



Letters chipped on the surface of this cake of ice are illuminated by light from behind.

or more electric lamps are suspended behind the cake and shielded in such a way that the light can pass only through the ice. When the light, in passing through the ice, strikes a place where the surface has been chipped and cracked, the rays are broken up into all the colors of the spectrum; this renders the letters or design visible in an unusual and most attractive way.

This idea, like the ice mountain described last month (P. S. M., Feb. '31, p. 93) and the illuminated blossoms in the preceding issue (P. S. M., Jan. '31, p. 85), was developed by L. C. Porter, a Cleveland electrical engineer.—V. B. C.

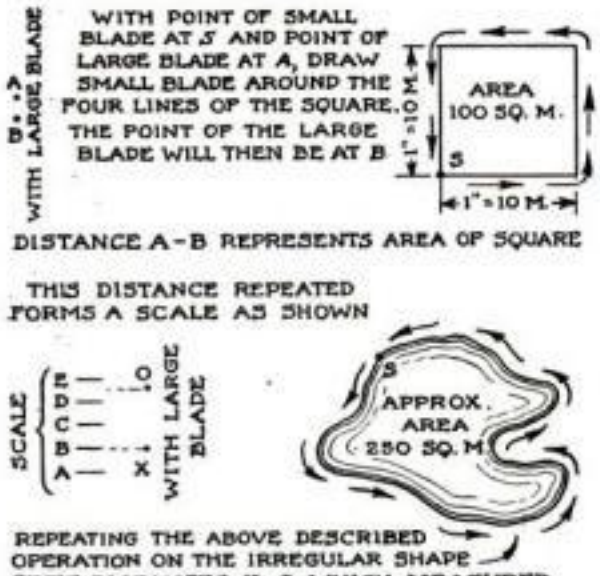
SMALL IRREGULAR AREAS MEASURED WITH AID OF POCKETKNIFE

During the tracing process the large blade is allowed to slide back and forth freely.

FOR computing the area of an irregular surface, as in the case of a lake shown on a map, the method illustrated is simple and surprisingly accurate.

First, a square of known dimensions is laid out to the scale of the area to be measured (in this instance a 1-in. square, representing 100 sq. mi.). A jackknife is next opened as shown, and the short blade is held lightly by the thumb and forefinger so that the point is against a corner of the square. The point where the large blade touches the paper is then marked. Keep the knife in an upright position and, allowing the large blade to "track" freely, move the end of the small blade around the lines of the square until the starting point is reached. The spot where the large blade now touches the paper is marked. The space between these two marks (indicated as *A* and *B* in the diagram below) is a unit which represents the area of the square.

Next, the procedure is repeated on the irregular surface. By tracing around the edge once, the distance *X-O* is determined. This distance is then compared to a scale of units *A-B*. If the distance *X-O* is found to be equal to two and a half times unit *A-B*, for example, the area of the irregular surface is two and a half times the area of the square.—H. S. RUDESILL.



How a square of known size is used to establish a scale for measuring an irregular area.

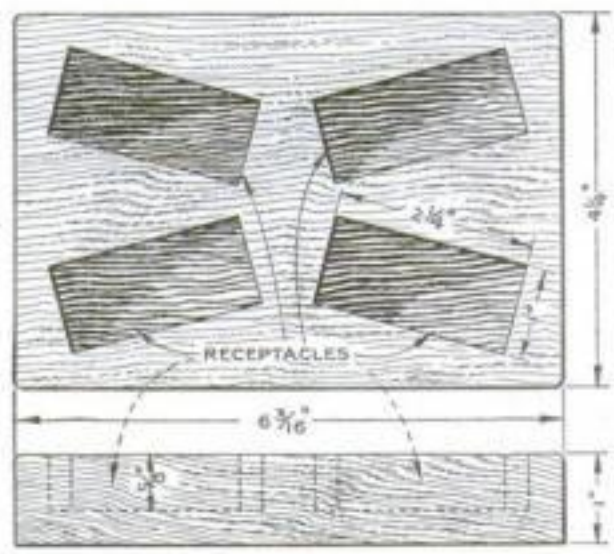
THIS CIGARETTE HOLDER GIVES YOU A CHOICE OF FOUR BRANDS

A neat and easily made "preference" holder with room for four packages of cigarettes.

CIGARETTE smokers become so partial to their favorite brands that the considerate host or hostess nowadays makes it a practice to offer a choice of packages. This can be done more easily if a neat, compact holder for the packages is made. The one illustrated, for example, allows a choice of four brands.

The construction is of the simplest. I used a piece of mahogany 1 by 4¼ by 6 3/16 in. On this I drew four rectangles as shown and drilled out the bulk of the waste wood with a small auger bit. It was then a simple matter to chisel away the sides and ends.

The holder should be stained the desired shade and given two coats of varnish. Rub the first coat with fine sandpaper or pumice and water, and the second coat with pumice and oil.—R. L. GRAVES.



Top and edge views of the holder. The four recesses are bored out roughly, then chiseled.

SALT REMOVES PLASTER OF PARIS FROM HANDS

HOME workers who have occasion to use plaster of Paris should know the secret of removing it from their hands—a trick I learned through observing my family doctor. When you are about to wash your hands after handling plaster of Paris, moisten them with water and sprinkle some common table salt over them. Rub the salt into your skin in the same manner as you would any kitchen cleanser. No soap is necessary; merely rub hard and briskly, using the salt freely. Then rinse your hands thoroughly and dry them.—JULES J. SIEKMAN.

A definite program for getting ahead financially will be found on page four of this issue.

Double-Duty Stand *for a* Baby's Bassinet

By C. A. ROSELL

FOR a very small baby's bed, a bassinet on wheels has several advantages. It can be moved from one room to another with the greatest ease, and for trips away from home the basket can be lifted bodily to an automobile without awakening the baby. The stand, too, is light enough to be transported in the car. Furthermore, a bassinet of this kind costs little to make,

Inexpensive bassinet, the stand of which can be used later as a "kitchen maid."

and later on the stand can be utilized, simply by adding a top, as a tea wagon or "kitchen maid."

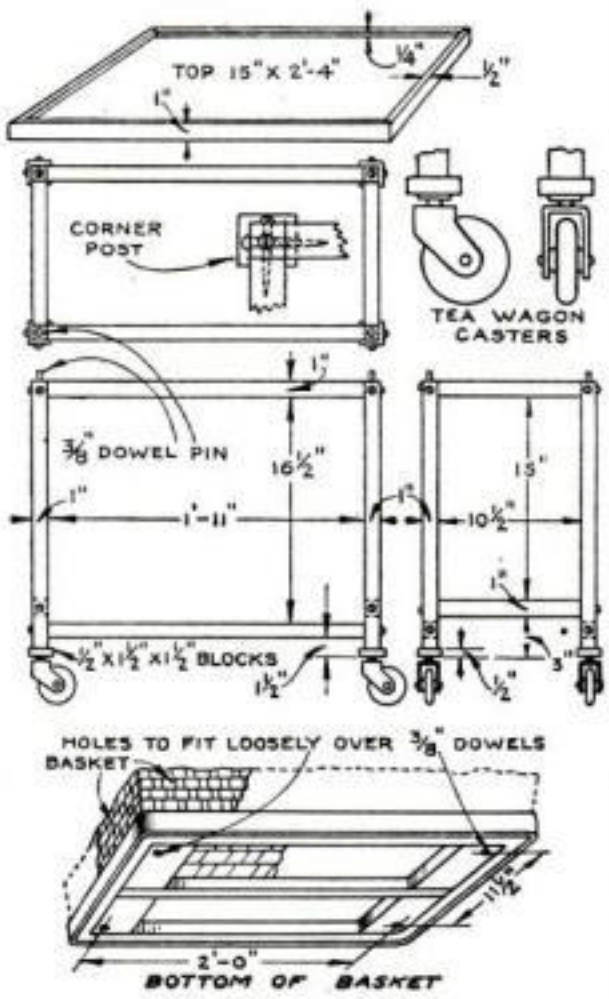
Built in the simple way shown, the stand for the basket requires few tools—a plane, saws, screw driver, ⅜-in. auger bit, brace, gimlet bits or drills, and sandpaper.

Use any wood hard enough to hold the screws in the end grain. Cut the pieces to the dimensions indicated in the accompanying bill of materials and assemble them as shown in the drawings. Cross braces may be used to stiffen the construction of the lower rails, but they were not found necessary for the stand built by the writer. Do not, however, use screws less than 2 in. long, because at best they hold only moderately well in end grain. Select high-grade ball bearing casters so the stand can be moved smoothly and guided easily.

It is obvious that the stand can be built with turned legs, if desired, and elaborated into a more ornamental piece of furniture, especially if it is to be converted into a tea wagon later on. Even in its plain form, however, it is attractive if

neatly painted, enameled, or lacquered in pink, blue, cream, or ivory color.

A basket of the type shown needs only the addition of four blocks with holes bored in them to slip over the projecting dowels in the stand. If a basket of another kind is used, nail a suitable frame-



How the stand is constructed, and details of the table top, basket, joints, and casters.

work to the bottom. Make the holes somewhat larger than the diameter of the dowels and countersink them a trifle so that they will slip on more easily. Also round off the upper ends of the projecting dowels.

When the baby has graduated to a little bed of its own, the stand can be changed into a tea wagon by adding a top with a molding nailed around the outside edge. The easiest way to fasten the top is to drive screws through the upper rails from the underside. A handle may be added, but if the stand is to be used in and about the kitchen for clearing the table, receiving dried dishes, and the like, it may be more convenient without one. A handle is likely to be in the way.

Materials for Stand

No.	Part	T.	W.	L.
4	Rails and stretchers	1	1	23
4	Rails and stretchers	1	1	10½
4	Legs	1	1	19½
4	Blocks	½	1½	1½
16	Round-head blued screws			2
4	Tea wagon casters, 2¼ diameter			
1	Dowel rod, ⅜ diameter			

Materials for Changing Stand to a Tea Wagon

No.	Part	T.	W.	L.
1	Top	¾	15	28
2	Molding	½	1	16
2	Molding strips	½	1	29

Note: All dimensions are given in inches.

HOMEMADE SIGN LIGHTED BY ALL THE COLORS OF THE RAINBOW

RAINBOW colors in ever-changing variety illuminate the letters of the sign illustrated. The effect is as striking as it is mysterious, yet the sign can be made by anyone handy with tools.

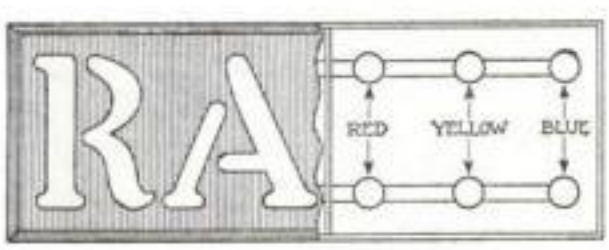
Wood, sheet metal, or a pressed wood composition may be used for the sign itself, the latter being recommended because it is particularly easy to cut with

This arresting sign is lit by colored lamps that flash on in ever-changing combinations.

an ordinary scroll saw or jig saw. Ground or opal glass should be placed under the letters to diffuse the light. For indoor use, ordinary linen tracing paper will serve.

Each section of the sign is provided with three or six lamps, one third of the lamps being red, one third blue, and one third yellow—the three primary colors.

Each lamp socket is provided with a thermostatic flicker. Such flickers can be purchased at any electrical store. Now consider what happens: the lights go on and off without any particular sequence with respect to one another. At one instant, the yellow lamps may be the only ones on; at other instances the red or the blue lights may be the only ones lighting the letters. When both red and yellow lights are on at the same moment, the letters are streaked with orange. When the blue and yellow lights flash on together, the letters appear green. In this manner the letters are continually changing colors, so that one sees nearly every color of the rainbow. The result is quite mysterious. In fact, one not knowing the secret is puzzled as to how so many colors are produced.—DANA S. GREENLAW.

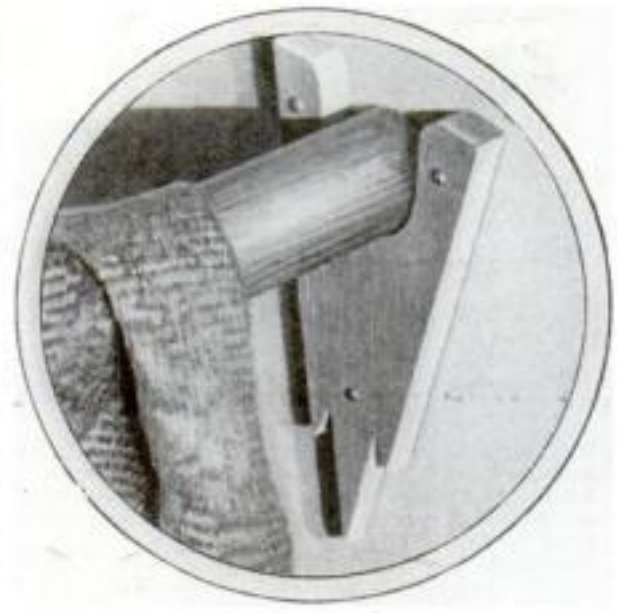


The sign partly broken away to show one set of colored lamps. The other side is the same.

WHEN varnish remover has been used on an open-grained wood, it is often necessary to refill the grain with paste filler.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

PORTIERE ROD SUPPORTS SAWED FROM WOOD

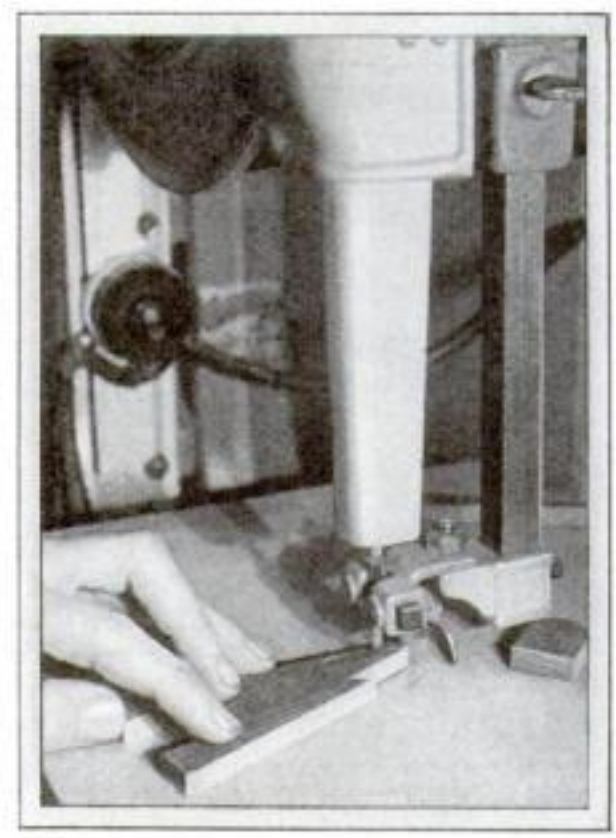


A modern looking, ornamental portière support cut from a waste scrap of veneered paneling.

DECORATIVE supports for a portière rod can be made in a few minutes with the aid of a band or jig saw, or a handsaw and an auger bit.

From ¼- or ⅜-in. stock, preferably veneered paneling, cut a pair of blocks in any suitable pattern such as that illustrated, which is a simple arrangement of triangles. Then, a short distance from the top, cut a circular hole of a size corresponding to the diameter of the rod to be supported, leaving the top open so that the pole can be inserted or removed easily. Drill three small holes in each support to receive brass escutcheon pins or screws, and finish the wood as desired.

The variety of design, size, and finish is unlimited, but take pains to have the supports harmonize in general style with the rooms on either side of the opening being draped.—W. E. B.



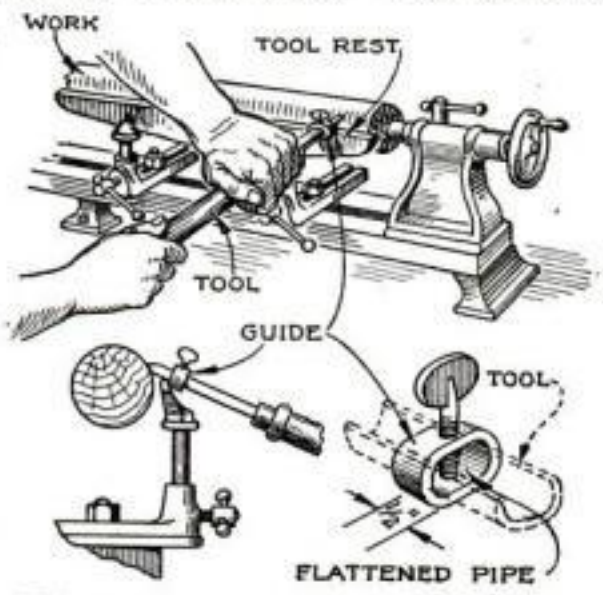
When a band saw is available, a pair of the supports can be cut out in a minute or two.

A CHEAP, useful cement of the celluloid type can be made by chopping two old celluloid toothbrush handles, less the brush ends, into a quarter pint can of lacquer thinner. With an occasional stirring, this will take about two days to dissolve.

GUIDE AIDS IN TURNING CYLINDERS AND TAPERS

IT IS often difficult for a beginner to turn true cylinders and tapers in a wood turning lathe. The accompanying drawing shows a guiding attachment for a lathe tool, the purpose of which is to make it easy to turn cylinders and tapers.

The guide may be made of pipe. Select a size of pipe slightly smaller than will admit the tool, and, after sawing off a section ½ in. long, flatten it until the tool will slip through easily. Then drill and



This wood turning guide clamps on the tool and slides like a gage along the tool rest.

tap the section of pipe for a thumbscrew. Flattening the pipe is necessary because it permits the use of an ordinary thumbscrew, which has a rather short thread. A stove bolt or a machine bolt also could be used, but a thumbscrew is more convenient to adjust.

To use this device in turning tapers, first turn a cylinder slightly larger in diameter than the largest diameter of the taper; then set the tool rest at the angle with the stock which corresponds with the taper desired, and proceed with the turning. Remove a little at a time from the work until the guide slides along the tool rest.—JOSEPH J. LUKOWITZ.

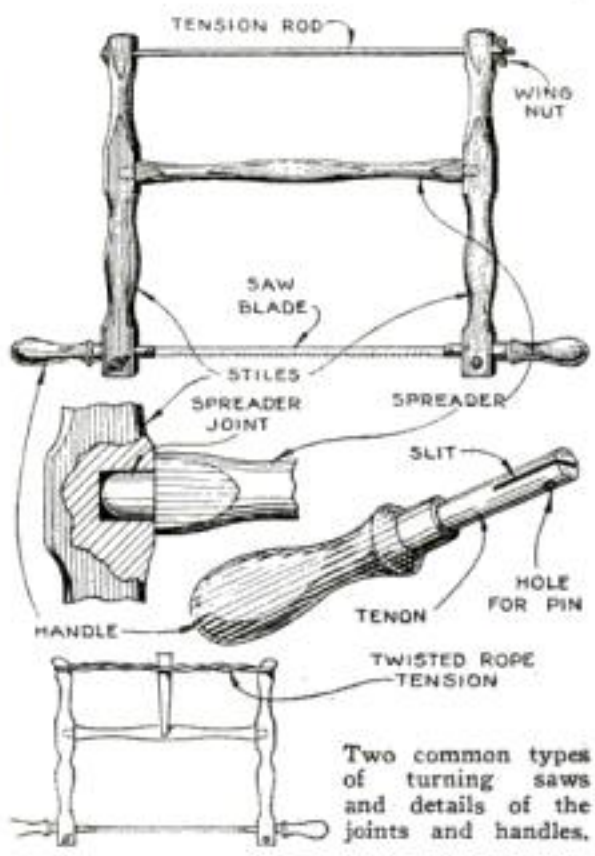
TUBING SERVES AS AIR VENT FOR FUNNEL

WHEN liquids are being poured through an ordinary tin funnel into a bottle or other small mouthed container, the funnel usually becomes air-bound. A simple remedy for this always annoying difficulty is to bend a length of small brass or copper tubing so that it will fit inside the funnel, as shown, and solder it in place.—JOHN B. ROSWICK.

The Turning Saw—So Old It's Now a Novelty

FOR cutting curves and irregular shapes by hand in wood, there is one inexpensive old saw which has many special advantages, yet relatively few home workers are familiar with it or own one. It is the turning saw (sometimes called a web or bow saw). In shape it resembles the bucksaw, but it has the advantage of a narrow blade which can be set at any angle to the frame. The turning saw serves effectively where it is impossible to use either the hand, compass, or fret saw.

The blade on a turning saw is not resharpened but is replaced by a new one when it becomes too dull for use. The blades, however, are exceedingly hard and will give many hours of use.



Two common types of turning saws and details of the joints and handles.

The size of a turning saw is determined by the length of its blade, the common sizes being 14, 18, 20, and 24 in. The range of price is generally from $1.50 to $2.50 for the frame and one blade. The blades are sold in 3/16- and 1/2-in. widths and can be obtained for from about $5 to $10 a dozen, depending on the length desired.

As a general rule the blade is inserted in the frame with the teeth pointing away from the operator, so that the saw cuts on the push stroke. In using the saw, clamp the work edge up in a vise, hold the saw in one hand, bracing it with the other, if necessary, and use slow, long, easy strokes, always keeping the saw blade at right angles to the surface of the work. In making sharp turns, run the blade up and down in the same place for a few strokes and at the same time turn the saw slowly until the proper direction is obtained. Avoid quick turns, as they tend to bend the blade and will often break it.

For those who wish to make their own turning saw frame, the use of either birch, maple, or ash is suggested for the stiles (sidepieces), spreader, and handles. For

A definite program for getting ahead financially will be found on page four of this issue.

a saw having a 14-in. blade the end stiles n y be 12 in. long, 1½ in. wide at the bottom tapering to ⅝ in. at the top, and ¾ in. thick. The blade is attached to the wide end. The spreader bar, ¾ in. square, which acts as a pivot for the end stiles, is fitted to these stiles with mortise and tenon joints and is located 8 in. above the saw blade. In the best construction, the tenons are short stubs and are rounded on the ends to allow a slight pivoting action, and, of course, are not glued.

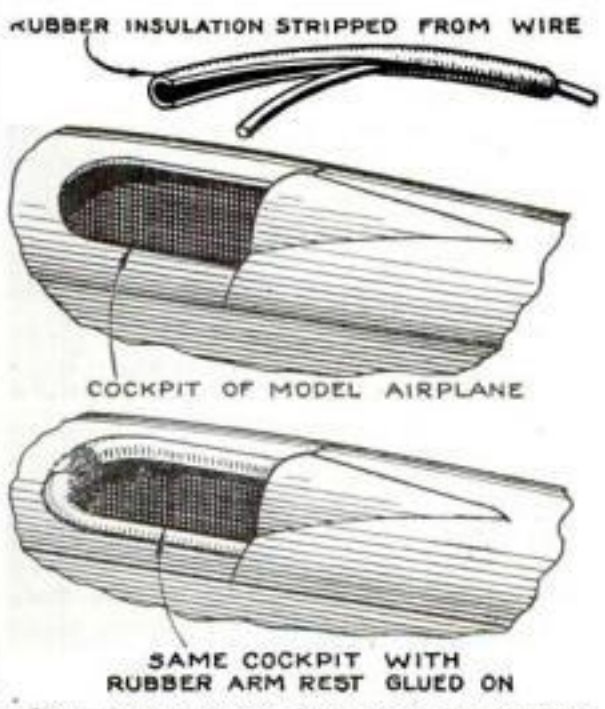
The tension rod, which pulls the smaller ends of the stiles together and thus supplies the necessary tension to the blade, can be a long bolt or it may be made from a piece of steel rod threaded to receive wing nuts at both ends.

In making the handles, stock must be allowed for the round tenons which fit into holes at the lower end of each stile. A saw cut is placed at the end of each tenon and a small hole is bored perpendicularly to this slot and ½ in. from the end. These slots and holes take the saw blades and pins respectively.

The stiles are slotted in the direction of the saw for a distance of 1 in. above the handle holes. Holes are bored at right angles to the slots, and bolts to take wing nuts are passed through. These slots and wing nuts serve to regulate the friction on the handles.

Some turning saws are supplied with a twist cord and stick instead of the steel tension rod and wing nuts. With this method the tension is applied to the blade by twisting the cord and locking it in position by means of the twist stick, which is placed so as to bear against the spreader bar.—S. S. PARKINSON.

PROVIDING ARM RESTS FOR MODEL PLANES



How the cockpit of a model plane can be edged with the rubber taken from an electric wire.

RUBBER insulated copper wire supplies the material for making realistic arm rests for scale model airplanes. Select wire of suitable diameter for the model being constructed, and strip off the silk covering, if any. Slit the insulation lengthwise sufficiently to allow the wire to be extracted. Paint the rubber, if desired, and also paint the cockpit of the plane. Then cement the arm rest to the edge of the cockpit as illustrated.—HENRY MARTIN.

UNIQUE STAND IMPROVES APPEARANCE OF SHIP MODEL IN BOTTLE

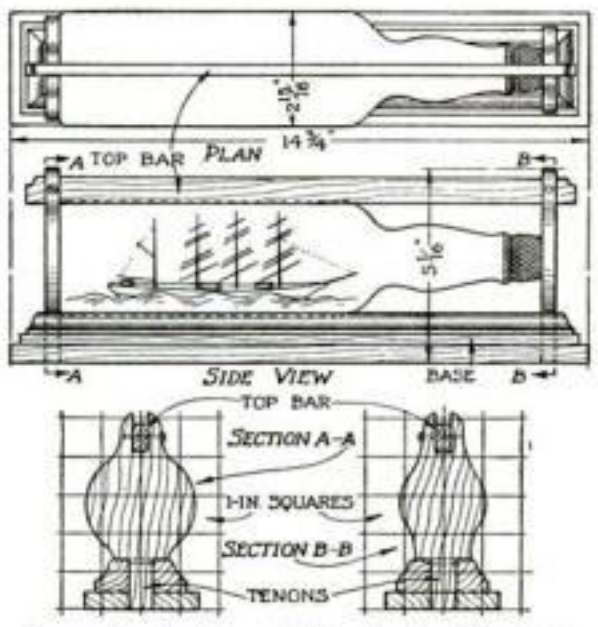
RECENTLY the writer had to design a stand for a ship model in a bottle which would raise a mere curiosity to the dignity of a real decoration. The problem was solved by making the stand as shown in the accompanying illustrations. Although the bottle is held securely, it can be rotated or removed by taking out two screws.

This stand avoids the common defect of giving the neck of the bottle undue prominence.

The molding shown is a waste piece of foot or bed molding. The profile of the sides was repeated at the ends by hand. Of course, any kind of molding of suitable size may be used; or two plain pieces of wood, one smaller than the other, may be glued on top of the ½-in. base.

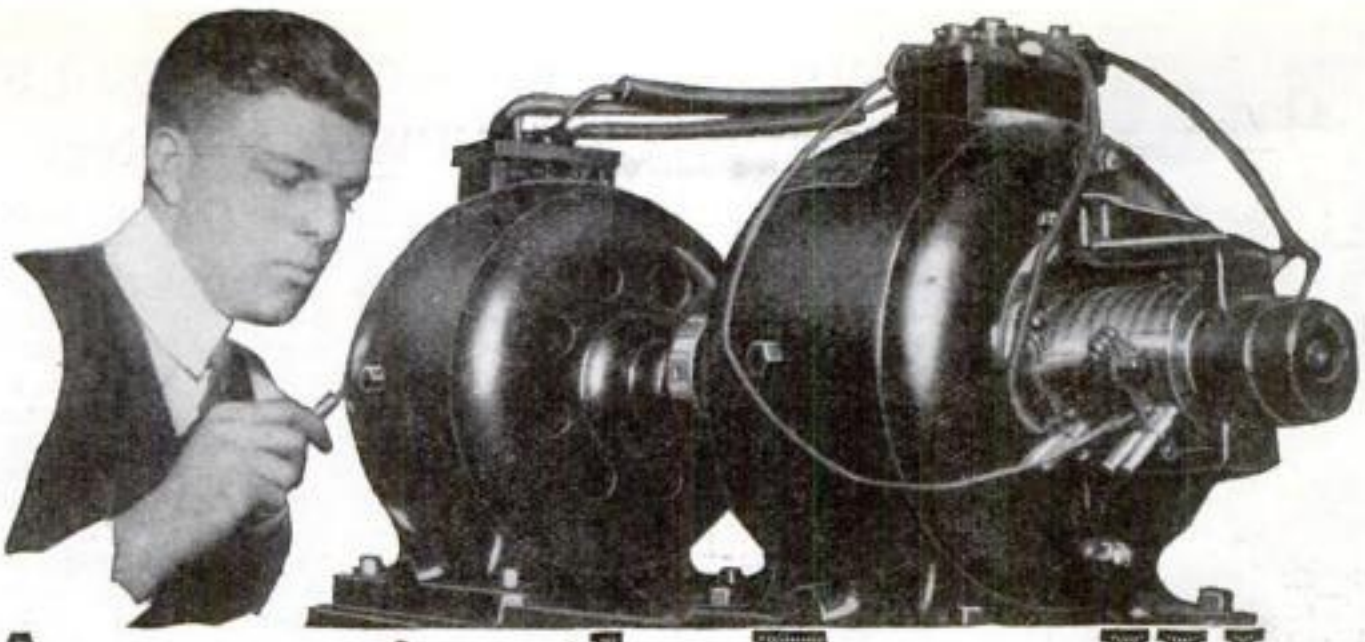
The ends of the stand, which conform to the size and shape of the bottle, are fastened to the base with mortise and tenon joints. The top bar is slightly hollowed out on the underside to fit the bottle, and the base is hollowed out on top in a similar manner. After being pressed down on the bottle, the bar is kept in place by two small roundheaded brass screws, as shown.

Any wood may be used. The stand illustrated was made entirely of white pine and finished as follows: One coat of dark mahogany oil stain, which was lightly sanded with worn No. 00 sandpaper when dry. One coat of shellac, lightly sanded after a few hours with slightly worn No. 00 sandpaper and well dusted. One coat of thin floor wax. Another coat of wax the following day. As a finishing touch, the mouth of the bottle was painted with antique bronze to hide the cork. This finish gave a rich effect, the dark frame bringing out the details of the ship model and softening the crudeness of the lines of the bottle.—GEORGE BROWN.



Top and side views of the stand and two sectional views showing the shape of the ends.

A definite program for getting ahead financially will be found on page four of this issue.



Amazingly Easy Way to get into ELECTRICITY

Don't spend your life waiting for $5 raises in a dull, hopeless job. Now . . . and forever . . . say good-bye to 25 and 35 dollars a week. Let me show you how to qualify for jobs leading to salaries of $50, $60 and up, a week, in Electricity —NOT by correspondence, but by an amazing way to teach, RIGHT HERE IN THE GREAT COYNE SHOPS. You become a practical expert in 90 days! Getting into Electricity is far easier than you imagine!

Learn Without Lessons in 90 DAYS
By Actual Work—in the Great Shops of Coyne

Lack of experience—age, or advanced education bars no one. I don't care if you don't know an armature from an air brake—I don't expect you to! I don't care if you're 16 years old or 48—it makes no difference! Don't let lack of money stop you. Most of the men at Coyne have no more money than you have.

EARN WHILE YOU LEARN

If you should need part-time work while at school to help pay expenses, I'll assist you to it. Then, in 12 brief weeks, in the great roaring shops of Coyne, I train you as you never dreamed you could be trained on a gigantic outlay of electrical apparatus . . . costing hundreds of thousands of dollars . . . real dynamos, engines, power plants, autos, switchboards, transmitting stations . . . everything from doorbells to farm power and lighting . . . full-sized . . . in full operation every day!

No Books-No Printed Lessons

No books, no baffling charts . . . all real actual work . . . right here in the great Coyne school . . . building real batteries . . . winding real armatures, operating real motors, dynamos and generators, wiring houses, etc., etc. That's a glimpse of how we make you a master practical electrician in 90 days, teaching you far more than the average ordinary electrician ever knows and fitting you to step into jobs leading to big pay immediately after graduation. Here, in this world-famous *Parent school*—and nowhere else in the world—can you get this training!

Prepare for Jobs Like These

Here are a few of hundreds of positions open to Coyne-trained men. Our free employment bureau gives you lifetime employment service.

Armature Expert, to $100 a Wk.
Substation Operator
$60 a Week and up
Auto Electrician $110 a Week
Inventor . . . . . Unlimited
Maintenance Engineer
up to $150 a Week
Service Station Owner
up to $200 a Week
Radio Expert up to $100 a Week

Jobs-Pay-Future

Dont' worry about a job, Coyne training settles the job question for life. Demand for Coyne men often exceeds the supply. Our employment bureau gives you a lifetime service. Two weeks after graduation, Clyde F. Hart got a position as electrician for the Great Western Railroad at over $100 a week. That's not unusual. We can point to Coyne men making up to $600 a month. $60 a week is only the beginning of your opportunity. You can go into radio, battery, or automotive electrical business for yourself and make up to $15,000 a year.

GET THE FACTS

Coyne is your one great chance to get into electricity. Every obstacle is removed. This school is 30 years old—Coyne training is tested—proven beyond all doubt—endorsed by many large electrical concerns. You can find out everything absolutely free. Simply mail the coupon and let me send you the big, free Coyne book of 150 photographs . . . facts . . . jobs . . . salaries . . . opportunities. Tells you how many earn expenses while training and how we assist our graduates in the field. This does not obligate you. So act at once. Just mail coupon.

Now in Our New Home

This is our new, fireproof, modern home wherein is installed thousands of dollars' worth of the newest and most modern Electrical Equipment of all kinds. Every comfort and convenience has been arranged to make you happy and contented during your training.

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WILL YOU LOSE YOUR JOB BECAUSE OF A NEW MACHINE?

(Continued from page 21)

for servicing and other tasks. It is like the spread of ripples on water when a stone is thrown into it.

Largely because of the use of labor-saving-machinery, Dr. Alexander went on to explain, wages have more than doubled since 1914, the last normal pre-war year. In the same period, the purchasing power of wages has gone up forty percent. Meanwhile, the demand for manufactured goods at lower prices has so increased that twenty-seven percent of the theoretically released workmen were put back at work and an additional 1,500,000 new men were employed.

Finally, he insisted, the research and invention that led to labor-saving methods often has resulted in the creation of entirely new products or the discovery of new uses for existing articles, the manufacture of which provides jobs for many men.

Official figures show that men thrown out of work by labor-saving devices in one industry are absorbed by others. The introduction of new machinery may change a man's work but does not put him in the bread line, according to a table and chart recently compiled by the U. S. Department of Commerce.

The figures cover these labor shifts between 1920 and 1927 in agriculture, mining, manufacturing, transportation, distribution, the U. S. Government service, professional, domestic, and personal service.

They show an increase of 817,000 in the total of men and women employed. There were 2,800,000 more holding jobs in transportation, distribution, professional, and personal service, and about 2,000,000 less in agriculture, mining, manufacture and Government service.

These figures, of course, do not give any detail concerning this constant shifting and absorption process. Take, for example, the automobile industry. Every auto factory and every accessory plant had to depend on men trained and let out by other industries. In 1930, 4,700,459 men worked in automobile factories and plants supplying them with raw materials and other products, such as rubber, frames, glass, upholstery fabrics, malleable iron, steel, and the like. The total also includes those employed in the production of gasoline, in servicing, filling stations, and garages.

BECAUSE it has thrown a number of so-called legitimate actors out of work the moving picture industry has been cited as an example of machinery destroying jobs. As a matter of fact, picture making has supplied a huge number of men and women with work. In 1920, 200,000 men were kept busy in the industry. By 1927, that number had grown to 350,000. As a result of sound pictures from 18,000 to 25,000 more, it is estimated, have been given jobs in the past three years. Many musicians who lost their jobs through the talkies, have been given work with the radio, which also has created new jobs for hundreds of technical men.

The development of the modern hotel, apartment house, office building, and restaurant, has provided jobs for an army of men. They permanently employ engineers, steam fitters, boiler men, electricians, machinists, firemen, carpenters, painters, elevator operators and service men. In 1927, 2,025,000 men had jobs of this kind. At present, it is estimated, their number is 2,225,000.

No amount of figures, however, can wipe out the fact that the United States, even in periods of greatest prosperity, suffers from unemployment. The reason for this, in the words of one economist, is that "technical knowledge and mechanical progress are much further advanced than is our understanding of political and social problems."

In other words, we do not know how to adjust ourselves to the machine age. Men, thrown out of work by new machines, join the unemployed class until the growing industry again gives them jobs. The trouble is mechanical progress is faster than absorption. A striking instance occurred a few years ago, when the Ford Motor Company spent one hundred million dollars to change its chief product from Model T to Model A. More than half of all production machinery was scrapped, and 60,000 men were laid off. These men, and probably more, have since been taken back, but meanwhile there was a great deal of suffering.

WHAT is the remedy? In the old days, the workmen took matters into their own hands and sought redress by physical violence.

Unemployment insurance, private and Governmental, has been suggested. The other day, former Governor Alfred E. Smith, of New York, urged the adoption of a system of public employment agencies in the various states, coöperating with a federal exchange. Such a plan would only be possible if Governmental machinery for the gathering of unemployment statistics first were created. A bill which is now pending in Congress provides for the establishment of such a special census.

Among the first private concerns to write unemployment insurance for its men is the General Electric Company, which is trying out an experimental program calling for premiums of one percent of wages to be paid by the employees while working. Payments consist of fifty percent of wages to those entirely unemployed and of a smaller amount sufficient to make up fifty percent of normal pay to those retained on less than half time.

Organized labor's remedy, according to Frank Morrison, secretary of the American Federation of Labor, is a drastic reduction of the work day and work week and increased wages that will expand labor's purchasing power and make possible a greater diffusion of wealth.

Whatever the cure, it will not be found in doing away with labor-saving devices. Scrapping all machinery is out of the question. To return to the primitive methods that prevailed before Watt's condenser made the steam engine practicable is unthinkable. Can you discard electric lights and put tallow candles and oil lamps back in your homes?

Inventive genius can no more help inventing than a duck can help swimming. The engineer's desire to develop and apply invention to a point where it will serve mankind is a wholly normal urge that can no more be checked than the child's instinctive desire to know.

No benefit can be derived from halting progress. The present problem, as a famous economist puts it, is the result of "mankind's spiritual development failing to keep pace with the rapidly developing elements of science and technology."

This means that unemployment is not an engineering problem but one that must be solved by the economist, the sociologist, and the expert in the science of government. It is their duty to devise methods whereby progress may continue unchecked until all have an opportunity to enjoy a safer, fuller, and happier life.

THIS HOME PLANNED FOR COMFORT

(Continued from page 79)

the floor as their base and reaching to the level of the drains and sinks, have been installed.

I used sana-onyx glass extending from the floor to a height of five and one half feet on the walls, the same glass being used in the construction of the drains. The remainder of the walls and the ceiling are in rough plaster.

BECAUSE the kitchen can be isolated completely from every other section of the house, the phone was put there. The disturbance created, even in large houses that are insulated as heavily as my small one, by phone ringing or phone conversations becomes irksome. I found this arrangement of the instrument in the kitchen relieved the situation. The kitchen and stairs to the basement are covered with inlaid, tile-pattern linoleum.

The bathroom is to the left immediately after entering the hall from the dining room. One of the bedrooms is to the right from the hall and the other opens into the end of the hall. Much of the left wall of the hall is taken up by the bathroom door and opposite this door I have built in a large linen closet.

Believing there was no necessity for a large, roomy bathroom in a house the size of mine, I designed an extremely narrow, but long, bathroom in duo-colored tile.

All woodwork in the house is stippled. I have used spruce in constructing all the interior doors, and the closet, door, and window frames are of red gum.

In order to insure heavily insulated walls I have utilized, as the chief item in the wall construction, one-inch balsam wool, inserted in the openings in the stud walls. Over the stud walls I laid ship-lap seven-eighths of an inch thick. My next step was to place an insulating paper over the ship-lap and then nail the metal lath to the walls.

Furrowing nails were used in attaching the metal lath to the walls, thereby giving a space of about a quarter inch between the sheathing to permit the cement stucco on the exterior walls to go through the holes in the metal lath, forming a secure key for the stucco.

In constructing the interior walls balsam wool was used. The stud wall then was covered with cypress lath and the plaster applied to the lath. I also used balsam wool between joists in the ceilings.

I have used composition fireproof roofing on both the residence and the garage. The garage also is of stucco, the walls constructed the same as the house and with metal, overhead, automatic doors.

Piping through the house is galvanized iron. Copper weather stripping was used on the door frames. This strip is nailed to the section of the doorframe into which the hinged strip of the door fits when it is closed.

IN construction of the floors throughout the house I have used hardwood only in the bedroom occupied by the owner. This was done entirely for personal preference and without any other purpose.

Instead of placing the hardwood over the one-by-six subflooring, I have covered the subfloor with ozite, one half inch thick, and then carpeted over this.

The living room, dining room, and hall are carpeted and I have used small rugs in the living and dining rooms to break the plainness of the carpet.

A large closet with double mirror doors takes up nearly all of one wall in my bedroom, which, although not large, is quite roomy. In order to break the regularity of the plaster tone as used in the other rooms the walls are paneled.

There are two north and two west windows, providing sufficient light and ventilation throughout the year. Wood drape rods and brackets, to contrast with the style and type in the fore part of the house, were used here.

After the house was completed, I made changes in the basement, which is one of the most important divisions of a bungalow. In my original design I included a furnace room, coal bin, storage room, toilet, and laundry room, the latter equipped with double sinks, water heater, and a water softener. I did not extend the basement forward beyond a line established by the rear of the living room. The reason for this was the low floor level of the living room.

IN order to get a downstairs social room, I revamped the basement, replacing the coal furnace with one of the automatic gas type. This change gave me much more space. I placed the new furnace near the base of the stairs and utilized the space occupied by the discarded coal furnace as a fruit room.

The partition that separated the storage and coal rooms was taken out, thus throwing them into a single, long social room. This room, although not yet completed, will have, as walls, the concrete blocks used as the foundation of the house and the ceiling will be of natural wood laid on the supporting crossbeams of the main floor of the house.

Because all the windows and exterior doors in the house open outwardly, I used humpback awnings over the windows and long, low, spear-supported awnings over the doors.

I installed interior screens and the windows are opened by turning cranks from the inside.

Having utilized as much of the lot as possible in front of the residence, it became apparent to me that with the two-car garage behind the house I would have but little remaining lawn to carry out the general exterior scheme. Any builder of a home of this type on a small lot probably will be confronted with the same problem. However, even though the remaining section is small, it can be so planned as to be highly decorative and thus prove an important feature of the general residence scheme.

USING the entire small square tract that remained, I placed, exactly in the center, a circular fish pond made of cobblestones with a narrow gravel walk surrounding it. The evenness of the pond is broken by a concrete bird bath placed in the center of the pond, and rising to several feet above the lawn. Again I have used flagstone walks in the rear yard. A row of small shrubs on the rear of this yard entirely separates my home and grounds from adjoining residences.

I already have admitted that should I build another home of the same general type I probably would make several changes, but such afterthought alterations are nearly unavoidable. Any number of circumstances that might occur over a period of a few weeks might have much to do with alterations in any residence, although there was no contemplation of changes or the results that could be accomplished by these changes when the original plans of the house were made.

I doubt if a house of a similar type could be erected at a lower cost, unless the builder only erected the framework of a real structure. Erection of a "shell house" for one who really wants a home is foolhardy.

WHY YOUR RADIO FAILS AT KNIFE-EDGE TUNING

(Continued from page 83)

broadcast band. Some are strong, and others are weak, depending on your location and the nearness of the broadcasting stations.

Obviously, if the station you desired to hear was only one tenth or one hundredth or even one thousandth as strong at your antenna as some other station on a near-by wave, the interfering station would drown out the desired station, since both waves would go through the tuning circuit, the powerful local station only slightly reduced in strength.

ONCE you understand that the coil and condenser working together merely allow one frequency to go through unimpeded and resist the passage of other frequencies only in proportion to the difference in frequency, you can see why it is necessary to use more than one tuning stage to get satisfactory results. The cumulative effect of several tuned stages, each of which pares away the strength of the unwanted signal, is needed to get the desired signal without too much interference.

Most people believe that a set for which "ten-kilocycle separation" is claimed should be able to choose between stations that far apart regardless of conditions. That isn't so. The average good set today will choose between stations only ten kilocycles apart if they are received at equal strength at your antenna, but no set made will allow you to hear the weaker of two stations if the other is hundreds or thousands of times as strong. Even if the tuning circuit reduces the strength of the stronger station to a twentieth or even as little as one hundredth of its original strength, it may still be stronger than the station you are trying to hear.

The paring away of the strength of unwanted stations, which is the cumulative effect of the several tuned stages, works roughly in proportion to the difference in frequency. That is why the superheterodyne circuit is, stage for stage, inherently a sharper tuning circuit than one with tuned radio-frequency amplification.

In the article explaining the operation of the superheterodyne circuit last month (P. S. M., Feb. '31, p. 84), it was shown how the "super" converts the incoming wave to a lower frequency and then amplifies at the lower frequency.

IF, FOR example, it is desired to choose between two stations ten kilocycles apart when the wanted station is operating on, say, 1,000 kilocycles, the difference in frequency between the wanted and unwanted stations would be only one percent.

If the same choice were to be made with a superheterodyne set using 175 kilocycles as the intermediate frequency, the difference between the two stations would still be ten kilocycles after conversion into the intermediate frequency. But ten kilocycles is nearly six percent of 175 kilocycles, and the superheterodyne would, in effect, be choosing between stations six times as far apart.

But the obvious theoretical advantage of the superheterodyne circuit over the tuned radio-frequency circuit is realized only to a limited extent in practice because the selective action of the intermediate frequency amplifier is not actually as great as the tuned stages of the other circuit, which operates at a much higher frequency.

The necessity of obtaining full and accurate tone quality puts a definite limit on the sharpness of tuning. If a set really had "hair-line selectivity" or "knife-edge tuning" it would respond only to a single frequency, and both speech and music would be so distorted as to be unrecognizable.

NEW TOOLS WAR ON FOREST FIRES

(Continued from page 43)

areas where the fire hazard is particularly great, the tractors often are used even before a fire starts. With them the region is cut into small patches to prevent the flames from spreading.

There are two general types of forest fires —the ground fire, in which the flames run along the ground through the leaves and underbrush; and the crown fire, in which they leap from tree top to tree top, racing with the wind. Crown fires are most dreaded and fortunately less frequent than ground fires. The only way they can be stopped is through unusually wide fire lines and the use of water to soak the trees in a wide swath in front of it.

RECENTLY, considerable advance has been made in designing hose equipment for this purpose. Gasoline-driven pumps, sucking water from creeks and streams and driving it through regular fire hose, have aided in halting a number of forest fires during the past season. Frequently such pumps saved the day. Regular trucks, carrying reels of fire hose, are now part of the equipment of some of the wilderness fire fighters.

For stopping ground fires, the digging of fire lines and the use of "back-firing" is most successful. In the latter method of fighting fire with fire, gasoline torches, supplied from a fuel tank carried on the back of the operator, are now used. The torch burns the combustible material on the ground to produce a barren strip that will stop the advance of the runaway flames.

Other workers, with shovels, stand ready to keep the fire started by the torch from escaping out of the area set for it. To help with this work, and to extinguish small fires, a hand spray that shoots water from a tank carried on the back is being tested.

Of all the new fire fighting weapons, the most spectacular, of course, is the airplane. At first Army planes were used. Now private concerns carry the winged lookouts over the forests on a contract basis. Besides being able to detect smoke from great distances, the flyers can make a close inspection of the fire a few minutes after it is sighted and report the exact conditions that will have to be met in fighting it.

At one time it was suggested that planes might bomb fire lines through the forests in front of advancing fires. The danger of campers being in the woods, where they could not be seen by the airmen, was considered too great to take chances.

THE danger of campers being trapped by a forest fire is always in the mind of the forest ranger. Last year, tests were carried on in California with planes carrying huge loudspeakers for the purpose of broadcasting warnings of the approach of a fire. Whether such machines will become part of the regular equipment of the service remains to be determined. The speakers also could be used by the supervisor to issue orders to the men on the ground.

Not long ago, a freak lightning storm in California set thirty-four small fires in the San Bernardino National Forest in twenty-four hours. The supervisor of the district, who took off in an airplane and patrolled the whole area, was able to direct the work at all of the widely separated points.

Lightning fires are a constant menace to forests. After every bad electrical storm, planes cruise over the timberlands on the lookout for such fires, often spotting them before they can get well under way. Another special service of the winged patrolmen is flying over the areas and watching for telltale smoke on days when the air is filled with haze, hiding the smoke from the regular watchers on mountain peaks.

Not only the forest patrol planes, but commercial ships as well, give valuable aid to the service. A few weeks ago, the pilot of one of the huge thirty-two-passenger Fokkers of the Western Air Express, making his regular run between Los Angeles and Salt Lake City, sighted a forest fire starting near Frazier Mountain Park. By means of his plane radio set, he notified his home office, which in turn sent a hurry-up message to the local forest service headquarters. The fire fighters were on their way to the spot a few minutes after the pilot sighted the blaze.

IN THE more remote parts of the national forests, which cannot be reached easily by road or trail, large emergency landing fields are being cleared out of the virgin timber. They will allow planes to bring men and supplies in case fire breaks out in the region, saving precious days in traveling time. These fields also give aid to the men who fly over the forests on patrol duty, allowing them to make safe forced landings if necessary.

Where fires used to burn for weeks before they were properly observed, planes now often carry expert foresters over them only a few minutes after they have started. Where they used to gain great headway before the fight to stop them had begun, they are now often stopped before they really get started. Where the fire fighters used to battle against tremendous odds with the crudest equipment, they now have scientific aids that increase their effectiveness. And the value of these aids is seen in the remarkable record that the service made last year.

FABULOUS RUBY FOUND IN INDIA, SAYS REPORT

FROM Mogok, in upper Burma, between India and French Indo-China, word has come down the Irrawaddy to Rangoon by wire and native runner that a 100-carat ruby has been found.

The news has aroused great interest in the world's jewel markets, but no more information has been given out, for ruby finds are surrounded with the greatest secrecy. A few rubies of as much as twenty carats have been found, but they have gone immediately into regally valuable collections of precious stones. In the absence of detailed information about the Mogok ruby there is no way of knowing its value—it may be priceless.

Rubies of one carat are usually worth twice as much as diamonds of the same weight, but those of ten carats may be worth ten times as much as an equal weight of diamonds. Their color varies from dark red to pale rose red, according to how the light strikes them. They sometimes contain a tinge of purple, and such species are the most valuable and the most eagerly sought after by collectors, who speak of them as "pigeon's blood" rubies. Also there are rubies having internal microscopic cavities which produce an optical effect known as asterism. They are called "star rubies" and are of great value. In hardness they are second only to diamonds, the hardest stones known.

Rubies are found in Burma and Siam, the best coming from the former country, where they are mined in a place called Pegu. Mogok is in the very limited territory in which these stones are now found in numbers. They are picked up in gravel and surface deposits formed of decomposed rock.

UGLY GREEN MOLD IS FOOD AND MEDICINE

(Continued from page 45)

making camembert cheese have only to place the raw cheese in the curing room, where it will gather the necessary surface mold. On the other hand, sustaining further the paradox presented by mold, roquefort cheese must always be inoculated with mold before it will begin to season. The reasons offered for this divergence of reaction is that roquefort must be infected throughout with mold while camembert carries only a surface mold, and that the molds belong to different families and, therefore, act differently.

DETERMINING classes of molds offered to him and identifying them is another problem which the student of the parasite has had to work out for himself. At present, identification of molds is limited almost entirely to a comparison of the ways in which they grow and in which they fruit. Each class of mold, true to its vegetable nature, puts forth characteristic fruit when it reproduces. Vegetable cells, such as mold, grow exactly as do fully developed plants.

The presence of mold in the earth is recognized. For instance, mold specialists say that every gram of earth contains between 50,000 and 100,000 pieces of mold. These pieces may be single microscopic cells or they may be mold colonies as large as the end of your thumb. Thus it is almost impossible to estimate the number of mold cells which may be found in a single tiny particle of earth.

If it is assumed, however, for the purpose of comparative accuracy, that each such "piece" is a single cell, it would be necessary to place 8,700 of them together to extend across the diameter of a dime.

That statement may readily be proved inaccurate when you remember that the mushroom is a form of mold; it is at least a member of the family to which the microscopic mold owes allegiance. And immediately the statement that mold is not poisonous is upset by reason of the fact that the toadstool and several other large fungi are deadly.

Thus mold presents a baffling problem. One of man's most costly enemies, it is at the same time a potential friend of incalculable usefulness. Although it is microscopic, one of its first cousins is a delicious delicacy. One of its manifestations, as mildew, is ruinous to cloth, but its use as a digestant for sizing chemicals saves cloth from destruction. A cause of one of the most terrifying respiratory ailments, it has proved to be the source of a drug essential in combating illness.

If its thousands of forms are ever finally determined, there is real promise that mold may not only be conquered, but that it may be turned to use as an agent of mankind in ways not now dreamed of by the most enthusiastic and hopeful of experimenters.

BUSINESS MAN BEATS FARMER PHYSICALLY

THE average business man makes a better showing physically than the average farmer, according to a recent health survey made by a New York organization. Physical examinations of 100,000 native-born men showed that business men have better eyesight, teeth, and hearing, and suffer less from lung trouble, than the average farmer. Farmers seem to be less affected by nose and throat ailments and nerve troubles than city workers. Stomach troubles, however, appear to play no favorites.

MERCURY TURBINE NOW A SUCCESS

(Continued from page 40)

This means that, while the average power plant is getting out of a pound of coal as much useful work as could be done by a strong horse in a little over three quarters of an hour, the mercury boiler installation is getting from the same amount of coal as much work as could be done by the same horse working for nearly two hours!

There is, therefore, no longer any doubt about the practical value of mercury boiler installations. However, talk of mercury entirely replacing water in the boilers of the world's power plants is a bit premature.

In the first place mercury vapor does not, even in the South Meadow plant of the Hartford Electric Company, entirely replace steam. The production of steam from water still is a vital part of the process.

IN THE second place, much as we may want to profit by the efficiency of the mercury vapor process, it remains an open question as to whether the world's supply of mercury can be increased sufficiently to provide for any large number of mercury vapor plants. Of course it must be remembered that, except for accidental losses, the mercury, once installed, can be used forever. It is not used up in generating power. A study of the process will show why this is so.

At the South Meadow plant, the mercury boiler consists of seven forged steel drums from each of which project 440 dead end tubes of low carbon steel. These projecting tube ends form the studded wall of the furnace chamber in which powdered coal is burned.

The liquid mercury is boiled into vapor in these tubes and passes by way of a pipe to a turbine that runs an electric generator. After turning the wheel of the turbine, the mercury vapor passes into what is actually a combination mercury condenser and steam boiler. The mercury vapor gives up its remaining heat to the water in the boiler and so produces steam.

This steam operates another turbo-generator and the mercury, again in liquid form, runs back into a boiler by way of a preheater located in the furnace chamber. The high boiling point of mercury, 675° Fahrenheit, thus makes possible the absorption of the maximum amount of heat from the fire and the subsequent economical use of this heat to produce power by the method outlined.

After the mercury vapor has developed 10,000 kilowatts by operating its own turbine, the heat remaining in it is sufficient to generate 128,000 pounds of steam an hour at a pressure of 280 pounds.

Note that the mercury simply circulates around in the system and is not lost or destroyed. Note, also, that it is the combination of the mercury vapor generation and the steam generation that makes possible the high efficiency.

NINETY tons is the weight of the liquid mercury in the boiler of the South Meadow plant, representing a value of $300,000—or at least that is what it would cost to replace at the current price of $125 a flask of seventy-five pounds. Of course when you consider that the total annual consumption of mercury in this country is only about 1,000 tons, it is obvious that it would be difficult, if not entirely impossible, either to buy or sell ninety tons of mercury in a single lot. These figures also show why a great increase in the production of mercury is necessary before it can be used widely in power generation.

Mercury long *(Continued on page 143)*

MERCURY TURBINE NOW A SUCCESS

(Continued from page 142)

has been one of our most neglected elements. It has been used in thermometers, barometers, percussion caps, mirror backing, cosmetics, insect destroying, medicinal disinfecting, roughening the hairs of felt products, anti-fouling ships' hulls and, lately, in giving blue color to neon lights.

You will find it in dentists' amalgam, as "roller bearings" for the Mount Wilson Observatory telescope, and you may have swallowed some of it in calomel.

In its relatively small use in arts and sciences, mercury has kept company with other now almost indispensible elements. For example, a widely read textbook of 1876 carries a picture of two little pieces of aluminum exhibited as rarities in the British Museum! Tungsten, through which we get much of our electric illumination; chromium, now recognized as a valuable rust reducer; vanadium, employed with chromium in making armor plate, were almost strangers to art and industry ten, twenty, or forty years ago.

YET mercury has been used in gold and silver mining since the early fifteenth century by Spaniards, Italians, and those who came later to be known as Americans. The Phœnicians were mining mercury in Spain long before the Christian era.

Because mercury has an affinity for gold and silver it played an important part in developing placer mining in North and South America. Most placer miners were spend-thrift fellows. Having used their mercury they abandoned it. Only last month an enterprising westerner told me that he was making good money by shoveling mercury out of California and Nevada sands or retrieving it from thousands of iron "flasks" in which it had been shipped from European or American miners to westerners who "washed" for gold.

The ninety tons of pure mercury from which the Hartford mercury boiler unit gets its unprecedented power arrived at the South Meadow plant in the same type of cast-iron "flask" in which it reached the miners after the great Sutter's Mill strike in California. Each cylindrical flask, about eleven inches high by four-and-a-half inches in diameter, weighs about ten pounds and contains seventy-five pounds of liquid mercury.

As a strong man could carry such a "flask" over mountain trails or sling two of them across a horse's back, they were ideal for mining under pioneer conditions. So little has the demand increased that mercury still is shipped in these archaic "flasks" and an order for ten tons of this element would have a serious effect on the market. Yet there is plenty of it available.

Mercury is found almost entirely in red-dotted sandstone, called cinnabar. Ninety percent of it comes from Spain and Italy. The Almadén Mine, in southern Spain, first worked by the Phœnicians, still produces from one third to one half of the world's mercury. Yet, even in Spain, production has not reached its limit. In 1927 Spain produced 52,599 flasks. During the next year it turned out 74,000 flasks. That same year, Italy mined 64,000 flasks of mercury.

DURING 1928 American mines produced about 17,000 flasks, mostly from California and Nevada. But during the peak war year of 1918, this country mined 32,883 flasks. So there is no scarcity of mercury.

Normally there is danger in working close to or with mercury. Mercurial poisoning manifests itself in decaying teeth or serious intestinal disturbances. At ordinary atmospheric pressure, mercury condenses at about 675 degrees F. (Continued on page 144)

MERCURY TURBINE NOW A SUCCESS

(Continued from page 143)

When the header of the Hartford Electric Company's boiler gave way at Dutch Point, the flue and stack temperature was rather high and much of the escaping element found its way into the Dutch Point yard.

Because of the relatively low specific heat of mercury and the low boiler pressure, a mercury boiler does not explode as a steam boiler does. Not until they noticed mercury falling in the level or gage glass did the Dutch Point workmen discover the boiler failure. At that time little thought had been given to the hazard of mercurial poisoning; hence, no precautions were taken during construction, operation, or reconstruction. Several workmen, therefore, were slightly poisoned by breathing mercury fumes. Light exercise in open air soon cured them. The most stubborn case lasted only four days.

WHEN one of the South Meadow boiler tubes gave way and a good deal of mercury escaped into the furnace, the coal supply was shut off and as the temperature at the base of the smokestack was only about 300 degrees, much of the mercury was recovered.

Better knowledge about welding has eliminated mercury leakage or loss at the South Meadow plant. But in order to provide for emergencies, the General Electric Company has developed a simple detector—a paper ribbon coated with selenium sulphide and unwound from a spool across an aperture through which gas or plain air is forced by a fan. The sulphide turns dark when in contact with mercury vapor or mercury.

In addition to this selenium paper, a photo-electric cell gives instant notice of the presence of mercury in flue gases by ringing a bell. All ventilation, where any leaks might occur, is delivered to the smokestack below the point of draw-off of the gases to the test paper. Hence, if a single tablespoonful of mercury were thrown into the boiler furnace a bell instantly would ring a warning.

When there is any possibility of workmen coming in contact with mercury vapor they wear face masks. If they are handling mercury or any parts that have been in contact with mercury, their hands are protected by rubber and leather gloves. If they are close to any mercury equipment, they wear overalls that are frequently washed. So far, none of the experimenters or their assistants has had a serious case of mercurial poisoning. And the loss of mercury has been negligible.

Though the South Meadow plant represents a large financial investment, it is not as great as the original estimate. Each hour, 1,100,000 pounds of mercury descends from the top of the unit to the boiler tubes. While ninety tons of mercury thus circulates six times an hour through the boiler, its descent is accomplished by gravity. Expensive boiler feed-pumps and valves and regulators thus are eliminated.

THE operation of the South Meadow unit is simple. There are no valves in the mercury cycle except a throttle valve, an emergency valve, and two safety valves on the turbine floor. In the event of excess pressure on the mercury boiler the latter are used to pass vapor into the condenser-boiler.

When heat from the coal fire has built up enough vapor pressure, the throttle is slowly opened until temperatures are uniform within the unit. The turbine is then started. By throttling the turbine the generator is cut in and synchronizing accomplished.

There are several reasons for believing that cost of electric production by means of a mercury unit can be reduced materially and that maintenance costs will be lower than for a straight steam station. As internal cleaning is not required a mercury boiler need not be opened, after being sealed. There are no scale deposits and no corrosion or pitting in the mercury boiler, and no tube failures due to scale formation from the water, as in ordinary steam systems.

As the mercury tubes are short and practically vertical, they easily can be cleaned externally. There is small probability that erosion, corrosion, or electrolysis will cause a failure in the condenser tubes. The condenser, though it has a "dual personality" because it acts both as a condenser and a steam boiler, will not suffer from burned or distorted tubes, because there is no fire underneath it. Hard scale will not form in its tubes because mercury vapor will be at a comparatively low temperature when it reaches the condenser from the turbine, and there is a vigorous circulation in the tubes.

BECAUSE simplicity of equipment affects dependability, a mercury plant will be more reliable than a modern all-steam plant, where refinements have introduced complications. As mercury does not attack steel, special construction materials are not necessary. Lightweight containers are practicable because mercury temperatures are high but pressures low.

Finally the initial cost of a mercury boiler system, plus steam capacity, is not greatly in excess of the cost of an equivalent all-steam system. But the overhead running cost, measured in kilowatts, is much lower than the best, most efficient steam plants now operated, and there is every reason for believing that the unit installed at South Meadow will run satisfactorily and efficiently without material repairs and replacements for a quarter century. It has run that way since February 4, 1930.

The results obtained since then clearly indicate that we may be passing from the age of steam to the age of mercury, at least so far as the generation of electric energy is concerned.

GRANDSON OF VERNE TO MAKE UNDERSEA TRIP

WHEN Jules Verne wrote his famous romance "Twenty Thousand Leagues under the Sea" and described the travels of the imaginary submarine *Nautilus*, he little dreamed that his own grandson would carry out his dream of sub-sea exploration. Now it is announced that Jean Jules Verne will be a passenger aboard Sir Hubert Wilkins' submarine *Nautilus*, formerly the U. S. Navy's *O-12*, when it starts this spring in an attempt to cruise under the ice to the North Pole.

Navy officials especially authorized use of the craft for the unique scientific expedition, and its present commander, Sloan Danenhower, persuaded the French descendant of the author to go along.

PLAN BIG TANK CARS

GIANT tank cars are the railroads' answer to competition from pipe line transportation of oil. The projected new cars will have a capacity of 22,000 gallons as against 10,000 gallons for the average car now in use. They will have a length of about forty-five feet, instead of thirty-five feet for the 10,000-gallon cars. Some roads have already built cars of from 12,500 to 16,000 gallons capacity, but these represent less than one percent of all tank cars in use.

A definite program for getting ahead financially will be found on page four of this issue.

STARTING TRICKS FOR COLD WEATHER

(Continued from page 86)

carburetor and crank by hand. The motor will start on the second or third quarter turn. You don't have to spin it. Of course if the motor is too stiff to turn by hand, pull out the choke and let the starter grind it over two or three times so the raw gas will cut the frozen oil on the cylinder walls. Wait a minute or two till the gas has had time to act, then give it the ether. If there's anybody with you, have the party hold out the clutch pedal while you crank. That cuts out the resistance of the stiff lubricant in the gear case, which holds back the gears like so much molasses."

"Suppose you can't get any ether, then what?" Whipton asked.

"YOU'D still have a couple of tricks left up your sleeve," said Gus. "One of 'em would be to short-circuit the resistance unit on the ignition coil while you get started. More current would flow and make a hotter spark, hot enough to ignite high-grade gas at zero. And by the way, if your motor is hard to start in winter, don't fool around with cheap gas. It always makes a motor harder to start than the 'premium' stuff.

"Closing up the spark plug gaps," Gus continued, "is another way to make winter starting easier. Cut the gap down to about half the regulation opening. Lots of cars are hard to start in winter for no other reason than that their owners forget the points burn away after thousands of miles of running. That makes the gap wider than it ought to be even for best summer going. That isn't the trouble with this motor, though, because I looked at the points the last time you had it in."

"Those tricks sound all right for an emergency," said Whipton, "but isn't there anything you can do to a car that will just naturally make it easier to start without having to try tricks?"

"Sure," Gus replied. "There's a primer you can fit on the dash. Working the plunger atomizes gas in the manifold. If you add a little tank to hold extra high test gas such as they use in airplanes, or even ether if the weather is exceptionally cold, that gadget will start you instantly.

"Then there's another type of primer that works electrically. It takes a minute or two to heat up the manifold. It's fine if you give your battery an extra charge now and then with a radio battery charger or if you do plenty of daylight driving.

"OF COURSE," Gus continued, "a lot depends on how you use your car. If you keep it in a heated garage and don't leave it standing in the streets more than an hour at a time, hard starting won't bother you. But if you keep it in a cold garage, the first start in the morning is going to be tough unless you do something about it.

"Some people put an electric grill or a toaster or even a big electric bulb under the hood right near the carburetor. Trouble is, if you leave the current turned on all the time, it runs into a lot of money, and there's always a chance of a fire if the carburetor should leak. The red-hot wires would ignite the gas. Of course the electric light bulb is safe enough, but you have to use a big bulb, not less than a hundred-watter.

"One fellow I know sticks a drop light with a hundred-and-fifty-watt bulb in it under the hood when he puts the car away for the night, and then he throws a blanket over the radiator. The next morning, about an hour before he wants to start out, he turns on the current. His garage light is wired to a switch in the house."

WILL AUTOGIRO BANISH PRESENT PLANE?

(Continued from page 30)

Although few people know it, Cierva was a famous airplane designer before he turned to his windmill craft. He built the first successful biplane in Spain and constructed the first tri-motored tractor in the world.

In 1910, when he was fourteen years old, he got into the air in a homemade glider by hiring a dozen boys at a penny apiece to pull him at the end of a long rope. Two years later, with a total capital of sixty dollars, he started his first motored machine. The propeller was carved from the wine-soaked wood of an old bar taken from a deserted inn. It was several pounds heavier on one end than the other, so the plane flew like a bucking broncho—but it flew.

LATER, in 1918, he designed a huge, eighty-foot, tri-motored passenger plane that was flown successfully. But the over-confident pilot stalled it in landing and spun into the ground. That spin led Cierva to believe that something was wrong with the entire system of airplane flight. He sought other means of getting off the ground; tried wing-flappers and helicopters. Finally, he worked out the whole theory of the autogiro on paper before he built even a model.

His first machine was built in 1920. It and several others that followed failed to fly. It was not until he gave the vanes complete freedom and depended upon centrifugal force that he succeeded. The first flight over a closed circuit in an autogiro was accomplished at Madrid, Spain, in 1923.

At the Pitcairn factory, machines have been flown practically every day for the past two years. They have been tested thoroughly and are to be put on the market in quantity production this spring.

For about 100 feet, I continued to settle toward the tower. Then I pushed the stick downward, picked up flying speed, and gave the Whirlwind the gun. I swung to the far side of the field and came in for a landing. This can be accomplished in two ways: either by gliding in, as in an airplane, or by "settling in" by a vertical descent. For my first landing, I picked the one I knew best and drifted in with a long slow glide. When I was twenty feet off the ground, I pulled back the stick. The nose of the ship rose and the whirling vanes checked our forward speed just as a crow spreads its wings and checks itself as it alights in a cornfield.

The autogiro is the only heavier-than-air craft that can slow down suddenly. Once Cierva took off toward a row of high trees, saw he could not clear the barrier, jerked back the stick at the last instant, and sat down seventy-five feet from the obstacles. An airplane would have crashed.

I HAD expected a terrific jolt when we hit the ground. Instead, we landed with a comparatively slight jar. Even when the ship descends vertically from high in the air the jolt of landing is about that of crossing a rough railroad crossing at twenty-five miles an hour in a well upholstered automobile. Because there is no long run after touching the earth, an autogiro can sit down on rough ground, even between frozen potato rows, without damage. Any small open space, wider than the windmill, serves as a landing field.

At the National Air Races, Ray was flying from Cicero, Ill., to the field where the contest was held when his engine cut out. He pulled back the stick and settled down on the pavement of a highway directly between two telephone poles, without the slightest damage.

In the thousands of hours that autogiros have been flown, nobody who has piloted one has been seriously injured. Once, a vane broke off high in the air and the pilot was only shaken up and bruised in landing. That accident occurred when Cierva was experimenting with rigid vanes. Since they have been made flexible there has been no repetition of the trouble.

Before the windmill lost momentum, I shoved the throttle wide open and took off on my second hop. Just clipping the tree tops, I cruised over the countryside at thirty-five miles an hour. A farmer chopping wood in a field stopped to look up. I waved and he waved back.

The most fun in flying is to fly low. And that is as dangerous as dynamite in an airplane. You have to fly up at 2,000 or 5,000 feet to have a safe gliding range in case the engine stops. Such flying is monotonous. It is like passing over a huge map. People are the size of pin heads. You want to see what is going on but dare not take the chance.

All this is changed with the autogiro. You can fly low and slow with safety. In case of engine trouble, you can drop down into any open space; you don't have to pick out a wide and level field.

THE more I flew the autogiro the more enthusiastic I became. Anyone who can learn to drive an automobile can learn to fly a windmill ship. Safety in an airplane depends more on the skill of the pilot. In an autogiro the human factor is reduced immensely. Ninety percent is taken care of by the machine itself.

They told me a student could master a windmill plane in a quarter the time it takes to learn to fly an airplane. The danger of the take-off is eliminated; the difficulty of landing is done away with; the menace of stalling and getting into a deadly tail spin is gone. It is the first plane designed for the average person.

After nearly half an hour in the air, I climbed to 1,000 feet above the center of the field and "settled in." Holding the ship level with the ailerons, I looked over the side of the cockpit and watched the yellow-brown rectangle of Pitcairn Field slowly expand as I settled toward it. A small chrome-yellow training plane scudded below me and sat down on the field with a long run, then taxied to the hangars. I was dropping slightly faster than a walk.

IT WAS like drifting down in a balloon. The earth seemed moving up to meet me. I had no sense of descent. There was no up-draft hitting my face. The spinning vanes above push down a column of air as well as act as a parachute.

Fifteen feet from the ground, I pulled back the stick, dropped the tail, and we sat down on three points. The wheels made less than half a turn on their axles; we rolled hardly six inches. I had landed less than a hundred yards from the first take-off where Ray was still standing.

The windmill overhead slowed down. The rotor tachometer hand touched ninety, then sixty, then forty. As they lost speed, the tips of the vanes began to drop. Finally, with the blades held up by the droop wires, the windmill came to a stop. I pulled back the rotor brake lever, locking it in place, and looked over at Ray. He grinned broadly and said:

"Well, now you are one of the first twenty-five pilots in America to fly an autogiro."

"That," I told him, "will be something to tell the grandchildren—when autogiros are everywhere!"

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NAVY RIDS AIRPLANES OF DEADLY GAS

(Continued from page 31)

The color of the blood samples tested was compared with that of a series of "standard" samples previously prepared so as to present the entire range of monoxide blood poisoning, between five percent and 100 percent absorption. Thus the laboratory expert could tell at a glance whether his test sample contained carbon monoxide, and if so, how much.

The air samples were taken from airplane cockpits and cabins with a rubber bulb device. It consisted of a pint-size vacuum bottle connected with a rubber tube the neck of which contained a small quantity of soda lime, which absorbed any gas except carbon monoxide.

When the bulb was pressed a pint of air was drawn in. The bottle was sealed and removed to the laboratory, where blood known to be free of carbon monoxide was added to the air. The blood then was put in a test tube and subjected to the same test as that taken from occupants of planes.

In this manner, all types of cabin planes tested were found to be free from the deadly gas. But it was shown to be present in two planes with open cockpits—one a bomber and the other an observation ship. A carbon monoxide absorption of fifteen percent was found in the blood of two occupants of the observation plane, and a ten percent absorption in that of the pilot and observer in the bomber.

These amounts are not alarming, resulting usually in a slight attack of headache or dizziness. Absorption of fifty percent is highly dangerous, causing unconsciousness or death, provided the gas has been in the blood eight minutes or more.

The Navy experts, however, considered a fifteen percent absorption sufficiently important to warrant special study, as it may result in chronic loss of muscular strength and mental alertness. For that reason, they devised the change in the direction of the exhaust leads in the two types of plane under consideration.

All the latest types of planes were tested. Experiments closely approximating actual flight conditions were conducted with bombing, observation, transport, and speed ships. Cross-country hops, power dives, acrobatic evolutions, and formation maneuvers were made.

The concluding test consisted of a cross-country flight from Washington, D. C., to Lakehurst, N. J., and back in the newest type of cabin plane. The flight was made by thirteen men, including Lieut. Commander White. No poison gas was revealed in the blood of any of them at the end of the trip.

CAR DRIVING WORDS NO LONGER ACCURATE

ARE modern automotive expressions too old-fashioned? An English dictionary writer says they are, proving his point by quoting the literal meaning of certain words used. The word "drive," for example, means to "force along, hurry on, to push or propel with force." Hence a driver is one who propels with force or urges on violently.

This was an excellent word when horses and cattle were the things driven, the critic says, but it is incorrect when applied to automobiles or other self-propelled vehicles. These all push or propel themselves; all their operators do is manipulate the controls which regulate their speed or course. The French word "conducteur," the Englishman believes, is a much more suitable word for indicating one who operates a self-propelled vehicle.

SCIENCE IS BLOODHOUND AT HEELS OF FORGER

(Continued from page 27)

An iron ink signature cannot be completely removed by chemicals. Even after it is invisible to the naked eye, it can be restored by applying ammonium sulphate, which reacts upon the iron salts buried in the paper and makes the original writing reappear.

Government checks are now protected both front and back against alteration by chemicals.

It is not only in tracing forged checks that Farrar is called upon to put his skill to the test. As examiner of questioned documents, he serves as expert witness in cases involving forged notes and questioned wills and is often called upon by Post Office officials to aid in tracing down the writers of anonymous "Poison Pen" letters.

IN this work, he often follows slender clues. In order to solve a "Poison Pen" mystery in a southern state, he made elaborate microscope photographs of the paper upon which the letters were written and also of paper found in the desk of the suspect. The fibers of the sheets were of similar make-up.

In another case, Farrar obtained more than twenty letters known to have been written by a woman who was suspected of penning a malicious anonymous letter. From these he cut out letters and words and fitted them together to duplicate the body of the anonymous letter. Then, even an unpractised eye could see that both had been produced by the same hand.

A very curious circumstance helped Farrar clean up the spectacular "poison gumdrop case" in Washington, D. C., three years ago. A man named Inelder Smith received through the mail a package of gumdrops filled with rat poison. The writing on the package corresponded with that of his wife, from whom he was separated. He brought the package and letters from his wife to Farrar for comparison.

THE address had been written on a piece of paper and pasted on the package. Farrar immediately saw that the writer of the letters had written the address. But on closer examination he discovered the name of a local garage in "phantom writing" across the address. This faint printing which results when a newspaper or printed card is carried in a pocket for a long time next to a white piece of paper, suggested a new possibility to Farrar.

Inelder had carried the letter and business card in his pocket. He had cut the address from an envelope his wife had sent him and pasted it on the package which he sent to himself. His wife was cleared of a serious charge.

Another type of puzzle with which the handwriting sleuth has to deal lies in the field of forged wills and documents.

One of Farrar's most interesting cases took place in Louisiana in 1927. In this a freak accident at a paper mill nearly twenty years before led to the undoing of the clever forger who produced a will dated 1902, which he said he found in an old trunk. It covered land upon which a $250,000 warehouse had been erected.

When Farrar was called to examine the document, he placed it on the ground glass plate of his examining table. The watermark read "erkshire Bond." He got in touch with the manufacturer of this paper, and found that this design had first been put upon the market in the spring of 1906.

Between December, 1907, and October, 1909, the letter "B" in the watermark had accidentally dropped off the dandy roll. Five different lots with *(Continued on page 150)*

SCIENCE IS BLOODHOUND AT HEELS OF FORGER

(Continued from page 149)

this defective water-mark had gone on the market, all after December, 1907. This testimony branded the will, dated 1902, as a forgery and cleared the title.

In examining documents of this kind, a study of the handwriting is only part of the job. In West Virginia, several years ago, a yellowed and apparently ancient deed covering 500 acres of valuable oil and coal lands was filed for record. It was dated 1888. When Farrar had finished his examination he had proved it a fraud in half a dozen ways. In his laboratory he examined the stains and found they contained caffeine, proving they had been made with coffee. The watermark showed that the paper of the deed had not been put on the market until twenty-eight years after the document was supposed to have been drawn. The cover of the deed contained a watermark that was not used until 1920. And the patent fasteners that held the deed together were invented in 1921.

The body of the deed had been written by a woman who was only five years old at the time the document was dated. Crooks who forge documents usually slip somewhere, but they seldom leave such a trail of damaging evidence behind as marked this West Virginia fraud.

Forged wills and notes made out after the death of the supposed writer are called "Foundling Wills" by the handwriting expert. Varied and ingenious explanations are often given to account for the discovery of such "ancient" documents. One such will was said to have been found in a pile of rubbish which was being burned in a backyard. A workman was supposed to have come to the bonfire to light a cigarette and to have discovered the document just before it caught fire. Even weirder was the explanation given in another case. Here a passerby was reported to have seen a rat run under a board in a deserted house. In pulling off the board to catch the rat, he discovered a valuable will hidden in the wall!

PLANTING THE SOUTH POLE IN CALIFORNIA

(Continued from page 22)

of lead so that they would collapse easily.

While the company was still on location at the old Government balloon school at Arcadia, near Los Angeles, residents of Arcadia awoke one warm sunny morning recently to see snow from the South Pole scattered over their lawns and gardens. Not real snow, of course, and not from the South Pole. The snow was gypsum that a wind storm had blown from a movie set that covered three square miles. Two million five hundred thousand pounds of gypsum constituted the South Polar snow.

IN addition to this large amount of "prop" snow, mechanical icebergs that rocked, ice that cracked open and swallowed actors alive, frozen breaths blown by actors into the California sunshine, and "ice barriers" added realism to the South Polar scenes in the finished frigid picture.

Real dirigibles and real planes were used in some scenes and in others duplicates, some models and some full sized, were employed.

When ready to shoot the scenes for "Dirigible," the director wanted to show the actors, wrecked at the Pole, blowing their icy breaths into the air. A staff surgeon first tried a mixture of two acids. These the actors held in receptacles in their mouths. When the acids, *(Continued on page 151)*

PLANTING THE SOUTH POLE IN CALIFORNIA

(Continued from page 150)

flowing through two tubes came together at the lips they formed the icy cloud. This arrangement was not foolproof, however, and the surgeon devised a new scheme.

He arranged with a Hollywood dentist to make plates of a cold resisting rubber composition to fit the upper and lower parts of the mouth. Then the actors took chunks of dry ice into their mouths. When they tried to talk with the ice and plates in place, their voices sounded muffled, as though they were nearly frozen instead of sweltering in heavy furs. And when they breathed through their mouths, the evaporating ice sent out clouds of "steam."

One actor, tiring of the plates, tried to carry the dry ice in his mouth. He emitted steam for a few minutes, but finally was carried from the set to a dental surgeon who removed four teeth. The dry ice had frozen his gums.

In building the reproduction of Admiral Byrd's Little America, mechanics first covered the ground with rough canvas and then covered this with 2,500,000 pounds of gypsum. Later, following directions on Government topographical maps, they constructed contours of "ice-covered" properties. Even the buildings were "buried" in the snow. Enough lumber to construct a town for 5,000 people went into the set. For the snowstorms, 700 tons of specially treated corn flakes, bleached to look like snow, were blown across the set by wind machines.

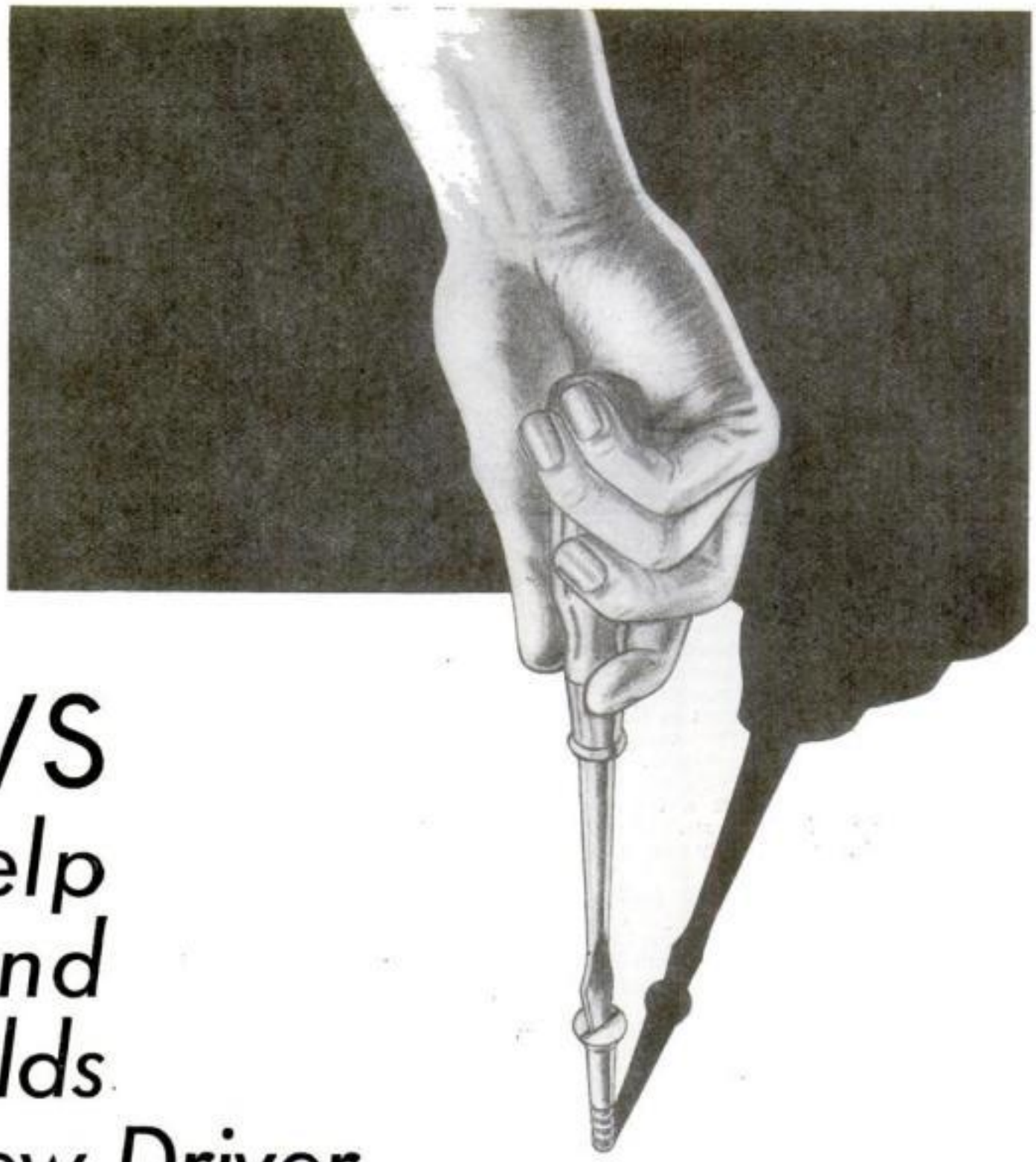
THE glare of the imitation ice proved more intense than the glare from South Polar ice. Five hundred pairs of sun glasses protected actors and workmen.

Huskies that had seen service with Admiral Byrd "acted" in some of the scenes. It became necessary to provide a special refrigerator in which the dogs rested. The one bit of acting required of the dogs nearly failed when the director found himself unable to coax a few howls from them. The wind machines were started, corn flakes flew all over the planes—but the dogs refused to howl. Then a property man suggested the lead dog be taken away. Immediately the rest of the pack set up a deafening howl and the camera recorded it.

Captain Parker's plane was supposed to be crashed at the South Pole by a pilot who was not aware of the lost ski. How was that filmed? A duplicate of the plane, complete in all external details, had been built. Even the light wood propellers whirled, and when hidden electric motors were started a large crane picked up the dummy until it dangled seventy-five feet above the earth. On signal, the plane was dropped on its nose. Immediately it burst into flames, aided by gasoline-soaked waste in the cabin. Eight cameras recorded the wreck.

Carpenters, with boards and canvas and gypsum, built the necessary icebergs, equipped with rollers and rockers. If the director wanted an iceberg, he had only to order one of any size, and it came rolling across a grass-covered field to the location where it would do the most good. Not only were the made-to-order icebergs wheeled here and there, but the rockers made it possible to sway them gently, thus creating the effect of slowly moving ice.

Long ago movie producers learned they could build scenes more nearly perfect than the originals. So with ice. Here they used an ice set because, during the eight weeks necessary to film various Polar scenes, they could not depend on any available mountain ice supply remaining constant in volume and shape. For pictures a scene must look the same in all episodes.



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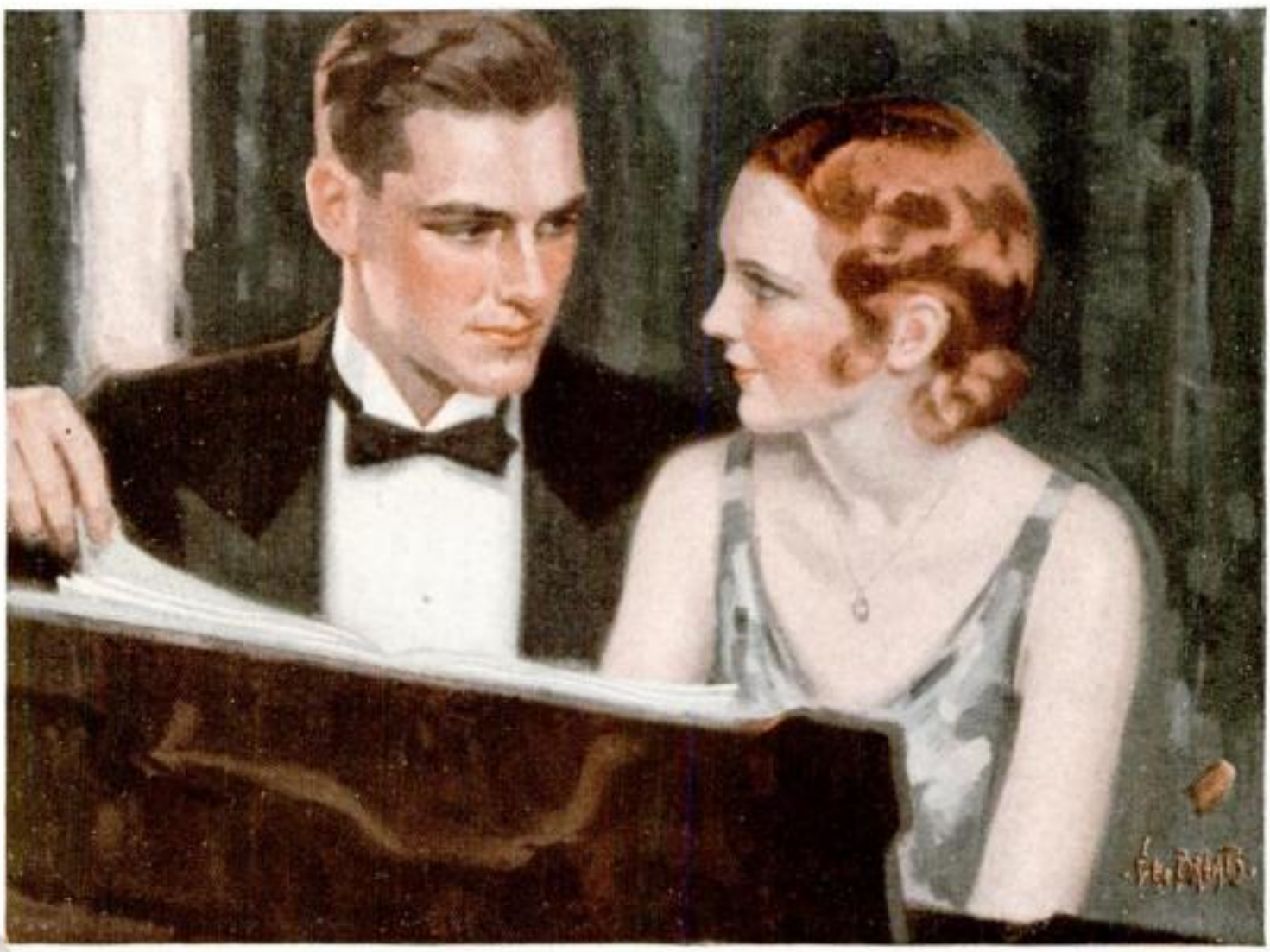
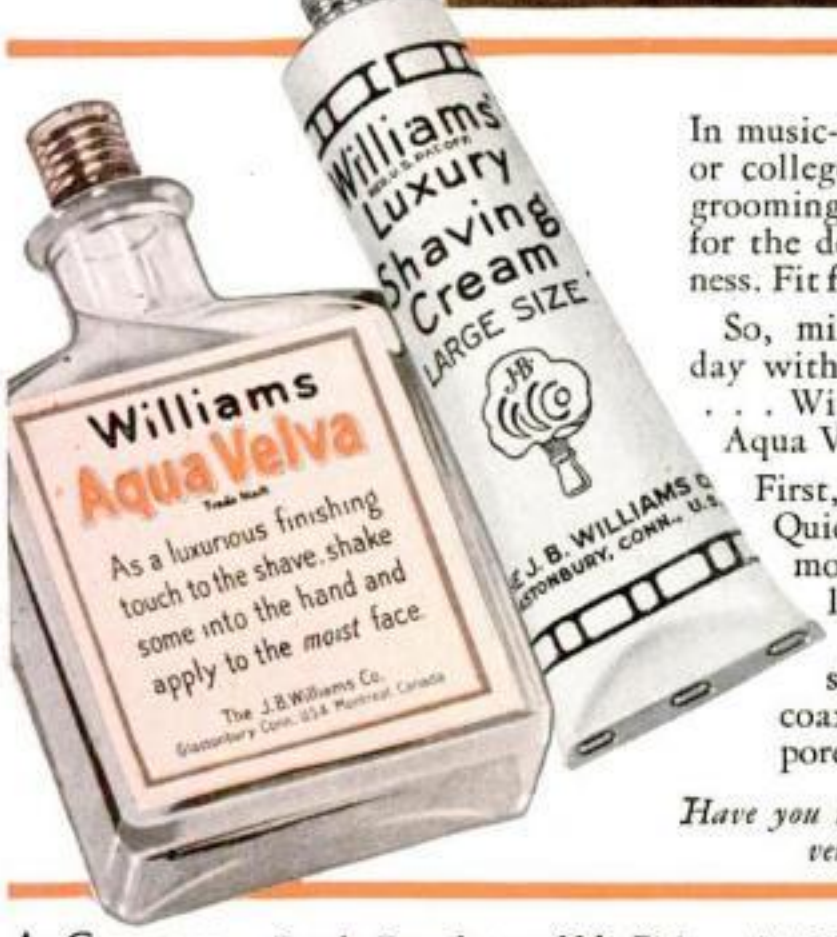
The Face *that's* Fit





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